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THIRTEENTH ANNUAL REPORT

OF THE

METROPOLITAN WATER AND SEWERAGE BOARD.

FOR THE YEAR 1913.

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CONTENTS.

PAGE
I. Organization and Administration, 1
Board, Officers and Employees, 1
II. Metropolitan Water District, 3
III. Metropolitan Water Works — Construction, 3
IV. Water Works — Maintenance, 5
(1) Storage Reservoirs, 5
(2) Aqueducts, 5
(3) Pumping Stations, 6
(4) Pipe Lines, 7
(5) Protection of the Water Supply, 8
(6) Forestry, 9
(7) Wachusett Power Plant, 9
(8) Rainfall and Water Supply, 9
(9) Water Consumption, 10
V. Water Works — Financial Statement, 10
(1) Water Loans — Receipts and Payments, 11
(2) Total Water Debt, December 31, 1913, 11
(3) Metropolitan Water Loan and Sinking Fund, 12
(4) Water Assessment, 1913, 12
(5) Supplying Water to Cities and Towns outside of District and to Water Companies, 13
(6) Expenditures for the Different Works, 14
(7) Detailed Financial Statement under Metropolitan Water Act, 16
(*a*) Expenditures and Disbursements, 16
(*b*) Receipts, 20
(*c*) Assets, 22
(*d*) Liabilities, 22
VI. Metropolitan Sewerage Works, 23
(1) North Metropolitan Sewerage System — Construction, 23
(2) North Metropolitan Sewerage System — Maintenance, 24
(*a*) Sewers and Pumping Stations, 24
(*b*) Tanneries and Gelatine and Glue Works, 25
(3) South Metropolitan Sewerage System — Maintenance, 26
Sewers and Pumping Stations, 26
VII. Sewerage Works — Financial Statement, 27
(1) Metropolitan Sewerage Loans, Receipts and Payments, 27
North Metropolitan System, 28
South Metropolitan System, 28
(2) North and South Metropolitan Loan and Sinking Funds, 29
(3) Annual Appropriations, Receipts and Expenditures, 30
(4) Sewer Assessments, 1913, 31
(5) Expenditures for the Different Works, 32
(6) Detailed Financial Statement, 33
(*a*) Expenditures and Disbursements, 33
(*b*) Receipts, 38
(*c*) Assets, 39
(*d*) Liabilities, 39
VIII. Recommendations for Legislation, 39

Report of Chief Engineer of Water Works, 45
General Statement, 45
Organization, 45

PAGE
Report of Chief Engineer of Water Works — *Concluded.*
Construction, ... 47
Extension of Works to Hyde Park, ... 47
Purchase of Works of the City of Boston in the Town of Brookline and City of Somerville, 48
Water Pipe Tunnel under Chelsea Creek, ... 50
Improvement of Beaver Dam Brook, ... 50
Maintenance, ... 51
Rainfall and Yield, ... 51
Storage Reservoirs, ... 51
Wachusett Reservoir, ... 52
Wachusett Dam and Grounds, ... 55
Sudbury Reservoir, ... 55
Framingham Reservoirs Nos. 1, 2 and 3, ... 56
Ashland, Hopkinton and Whitehall Reservoirs, ... 57
Farm Pond, ... 57
Lake Cochituate, ... 57
Miscellaneous Work on Sudbury Watershed, ... 58
Sources from which Water for the Supply of the Metropolitan District has been taken, 58
Aqueducts, ... 58
Wachusett, ... 58
Sudbury, ... 59
Cochituate, ... 60
Weston, ... 60
Sewers along Sudbury and Cochituate Aqueduct Lines, ... 61
Pumping Stations, ... 62
Chestnut Hill, ... 63
Spot Pond, ... 67
Arlington, ... 68
West Roxbury and Hyde Park, ... 68
Consumption of Water, ... 69
Metering of Service Pipes, ... 73
Water supplied Outside the Metropolitan District, ... 74
Quality of Water, ... 74
Sanitary Inspection. 76
Swamp Ditches and Brooks, ... 80
Protection of the Supply by Filtration, ... 81
Forestry, ... 82
Distributing Reservoirs, ... 86
Weston Reservoir, ... 87
Chestnut Hill Reservoir, ... 87
Waban Hill Reservoir, ... 87
Fisher Hill Reservoir, ... 87
Forbes Hill Reservoir and Standpipe, ... 88
Mystic Reservoir, ... 88
Mystic Lake, ... 88
Spot Pond, ... 88
Fells and Bear Hill Reservoirs, ... 88
Pipe Yards, ... 89
Pipe Lines, ... 89
Fox Hill Bridge, ... 89
Relaying 24-inch Main on Broadway in Chelsea, ... 90
Anderson Bridge, ... 90
Connection with Mains of the City of Malden for Emergency Use, ... 91
Check Valve at Winthrop, ... 91
Miscellaneous, ... 91
Leaks, ... 92
Meters, ... 93
Recording Gages, ... 94
Electrolysis, ... 94
Clinton Sewage Disposal Works, ... 95
Hydro-electric Power Station, ... 97
Engineering, ... 99

PAGE
- Report of Engineer of Sewerage Works, 100
  - Organization, 100
  - Metropolitan Sewerage Districts, 100
    - Areas and Populations, 100
  - Metropolitan Sewers, 101
    - Sewers purchased and constructed and their Connections, 101
  - Construction, 104
    - North Metropolitan System, 104
      - Section 68, Winchester, 105
      - Section 69, Winchester, 106
      - Section 70, Winchester and Woburn, 106
      - Section 30, Cambridge, 107
      - Section 48A, Somerville, 107
      - Screening Machinery at East Boston Pumping Station, 108
  - Maintenance, 109
    - Scope of Work and Force employed, 109
    - Grade Crossing at Medford Street, Somerville, Fitchburg Division of the Boston & Maine Railroad, 109
    - Grade Crossing at Orient Heights, Boston, Revere Beach & Lynn Railroad, 110
    - Deer Island Pumping Station and Dwelling, 110
    - East Boston Pumping Station, 110
    - Charlestown Pumping Station, 110
    - Alewife Brook Pumping Station, 110
    - Shirley Gut Siphon, 111
    - Ward Street Pumping Station, 111
    - Nut Island Screen-house, 111
    - Drainage from Tanneries and Gelatine and Glue Works in Winchester, Woburn and Stoneham, 111
    - Data relating to Areas and Populations contributing Sewage to Metropolitan Sewerage System, 113
      - North Metropolitan System, 113
      - South Metropolitan System, 114
      - Whole Metropolitan System, 115
    - Pumping Stations, 116
      - Capacity and Results, 116
        - North Metropolitan System, 116
          - Deer Island Pumping Station, 116
          - East Boston Pumping Station, 117
          - Charlestown Pumping Station, 119
          - Alewife Brook Pumping Station, 120
        - South Metropolitan System, 122
          - Ward Street Pumping Station, 122
          - Quincy Pumping Station, 123
          - Nut Island Screen-house, 125
          - Quincy Sewage Lifting Station, 125
    - Metropolitan Sewerage Outfalls, 127
    - Material intercepted at the Screens, 128

- Appendix No. 1. — Contracts relating to the Metropolitan Water Works made and pending during the year 1913, 120
- Appendix No. 2. — Tables relating to the Maintenance of the Metropolitan Water Works, 137
  - Table No. 1. — Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works in 1913, 137
  - Table No. 2. — Rainfall in Inches at Jefferson, Mass., in 1913, 138
  - Table No. 3. — Rainfall in Inches at Framingham, Mass., in 1913, 139
  - Table No. 4. — Rainfall in Inches at Chestnut Hill Reservoir in 1913, 140
  - Table No. 5. — Rainfall in Inches on the Wachusett Watershed, 1897 to 1913, 142
  - Table No. 6. — Rainfall in Inches on the Sudbury Watershed, 1875 to 1913, 143
  - Table No. 7. — Yield of the Wachusett Watershed in Gallons per Day per Square Mile from 1897 to 1913, 145

PAGE

Appendix No. 1 — Continued.

Table No. 8. — [illegible] Sudbury [illegible] Gallons per Day per Square Mile from [illegible] . . . 147
Table No. 9. — Wachusett System. — Statistics of Flow of Water, Storage and Rainfall in 1913 . . . 150
Table No. 10. — Sudbury System. — Statistics of Flow of Water, Storage and Rainfall in 1913 . . . 151
Table No. 11. — Cochituate System. — Statistics of Flow of Water, Storage and Rainfall in 1913 . . . 152
Table No. 12. — Elevations of Water Surfaces of Reservoirs above Boston City Base at the beginning of each Month . . . 153
Table No. 13. — Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District . . . 154
Table No. 14. — Average Daily Quantity of Water drawn through Aqueducts in 1913 by months . . . 156
Table No. 15. — Statement of Operation of Engines Nos. 1 and 2 at Chestnut Hill Pumping Station, No. 1, for the Year 1913 . . . 157
Table No. 16. — Statement of Operation of Engine No. 3 at Chestnut Hill Pumping Station, No. 1, for the Year 1913 . . . 158
Table No. 17. — Statement of Operation of Engine No. 4 at Chestnut Hill Pumping Station, No. 1, for the Year 1913 . . . 159
Table No. 18. — Statement of Operation of Engines Nos. 5, 6 and 7 at Chestnut Hill Pumping Station, No. 1, for the Year 1913 . . . 160
Table No. 19. — Statement of Operation of Engine No. 12 at Chestnut Hill Pumping Station, No. 2, for the Year 1913 . . . 161
Table No. 20. — Statement of Operation of Engine No. 8 at Spot Pond Pumping Station for the Year 1913 . . . 162
Table No. 21. — Statement of Operation of Engine No. 9 at Spot Pond Pumping Station for the Year 1913 . . . 163
Table No. 22. — Statement of Operation of Engine No. 10 at Arlington Pumping Station for the Year 1913 . . . 164
Table No. 23. — Statement of Operation of Engine No. 11 at Arlington Pumping Station for the Year 1913 . . . 165
Table No. 24. — Statement of Operation of Engines Nos. 13 and 14 at Hyde Park Pumping Station for the Year 1913 . . . 166
Table No. 25. — Meter Rates, Average Daily Consumption of Water by Districts in Cities and Towns supplied by the Metropolitan Water Works in 1913 . . . 167
Table No. 26. — Meter Rates, Average Daily Consumption of Water in Cities and Towns supplied from Metropolitan Works in 1913 . . . 168
Table No. 27. — [illegible] Consumption of Water in the Metropolitan Water District, as constituted in the Year 1913, and in [illegible] in the Town of [illegible] from 1896 to 1913 . . . 171
Table No. 28. — Chemical Examinations of Water from the Wachusett Reservoir, Clinton . . . 173
Table No. 29. — Chemical Examinations of Water from the Sudbury Reservoir . . . 174
Table No. 30. — Chemical Examinations of Water from Spot Pond, Stoneham . . . 175
Table No. 31. — Chemical Examinations of Water from Lake Cochituate . . . 176
Table No. 32. — Chemical Examinations of Water from a Tap at the State House, Boston . . . 177
Table No. 33. — Averages of Examinations of Water from Various Parts of the Metropolitan Water Works in 1913 . . . 178
Table No. 34. — Chemical Examinations of Water from a Faucet in Boston, from 1892 to 1913 . . . 179
Table No. 35. — Microscopic Organisms in Water from Various Parts of the Metropolitan Water Works, from 1896 to 1913, inclusive . . . 180
Table No. 36. — Number of Bacteria per Cubic Centimeter in Water from Various Parts of the Metropolitan Water Works, from 1896 to 1913, inclusive . . . 181
Table No. 37. — Colors of Water from Various Parts of the Metropolitan Water Works in 1913 . . . 182
Table No. 38. — Temperatures of Water from Various Parts of the Metropolitan Water Works in 1913 . . . 183
Table No. 39. — Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1913 . . . 184

PAGE

Appendix No. 2 — *Concluded.*

Table No. 40. — Table showing Length of Main Lines of Water Pipes and Connections owned and operated by Metropolitan Water and Sewerage Board, and Number of Valves set in Same, Dec. 31, 1913, ... 185

Table No. 41. — Statement of Cast-iron Hydrant, Blow-off and Drain Pipes, owned and operated by Metropolitan Water and Sewerage Board, Dec. 31, 1913, . 186

Table No. 42. — Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1913, ... 187

Table No. 43.— Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, ... 188

Table No. 44. — Average Maximum Monthly Heights, in Feet, above Boston City Base, to which Water rose at Different Stations on the Metropolitan Water Works in 1913, ... 189

Appendix No. 3. — Water Works Statistics for the Year 1913, ... 191

Appendix No. 4. — Contracts relating to the Metropolitan Sewerage Works, made and pending during the year 1913, ... 194

Appendix No. 5. — Financial Statement presented to the General Court on Jan. 19, 1914, . 199

Appendix No. 6. — Legislation of the Year 1913 affecting the Metropolitan Water and Sewerage Board, ... 204

METROPOLITAN WATER AND SEWERAGE BOARD.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan Water and Sewerage Board, established under the provisions of chapter 168 of the Acts of the year 1901, has already presented to your Honorable Body an abstract of the account of its doings, receipts, expenditures, disbursements, assets and liabilities for the fiscal year ending on November 30, 1913, and now, in accordance with the provisions of chapter 235 of the Acts of the year 1906, presents a detailed statement of its doings for the calendar year ending on December 31, 1913, being its

THIRTEENTH ANNUAL REPORT.

I. ORGANIZATION AND ADMINISTRATION.

BOARD, OFFICERS AND EMPLOYEES.

The term of office of James A. Bailey, Junior, expired on March 20, and Charles S. Hamlin was appointed for the term of three years next succeeding. Mr. Hamlin resigned on August 1, and on September 18 Edward A. McLaughlin was appointed for the unexpired term, ending March 20, 1916. At the end of the year the Board consisted of Henry H. Sprague, chairman, Henry P. Walcott, M.D., and Edward A. McLaughlin. William N. Davenport has continued as secretary. Alfred F. Bridgman has been the purchasing agent and Miss Alice G. Mason the bookkeeper.

There are also employed in the administrative office a paymaster, an assistant in auditing, two general clerks, three stenographers and clerks, a telephone operator, a messenger, and a janitor with two assistants, one of whom acts as watchman.

Such general conveyancing work and investigation of real estate titles in the different counties as have been called for during the year have been performed by George D. Bigelow.

The consulting engineers of the Board are Hiram F. Mills and Frederic P. Stearns, who are called upon for services when matters arise which require their consideration.

Dexter Brackett, Chief Engineer of the Water Works, has had supervision over the various departments of both construction and maintenance of the Water Works. William E. Foss has been Assistant to the Chief Engineer. The following have also continued as superintendents of departments under the direction of the Chief Engineer: Elliot R. B. Allardice, Superintendent of the Wachusett Department; Charles E. Haberstroh, Superintendent of the Sudbury and Cochituate Works and of the portion of the Weston Aqueduct above the Weston Reservoir; Samuel E. Killam, Superintendent in charge of the Weston Reservoir and the remaining portion of the Weston Aqueduct, and of all reservoirs and pipe lines within the Metropolitan District; and Arthur E. O'Neil, Superintendent of the several pumping stations.

There has been a still further decrease in the number of the engineering force during the past year. The average force employed on construction and maintenance during the year has included, in addition to the Chief Engineer, 4 department superintendents, 2 division engineers, 8 assistant engineers and 27 others in various engineering capacities and as sanitary inspectors, clerks, stenographers and messengers, the total force numbering 42.

A maintenance force in addition to those engaged in engineering capacities, as above mentioned, numbering upon the average during the year 241, has been required at the pumping stations, upon reservoirs, aqueducts, pipe lines and upon minor construction work. At the end of the year this force numbered 225.

Frederick D. Smith, Engineer of Sewerage Works, has had charge of both construction and maintenance of the works. He has been assisted by Henry T. Stiff, Division Engineer in charge of the office and drafting, by 2 assistant engineers and by 11 others employed in different engineering capacities, and by 2 stenographers and clerks.

The maximum engineering force employed at any one time during the year on the construction and maintenance of the Sewerage Works was 17.

The regular maintenance force required in addition for the operation of the pumping stations, the care and inspection of the sewers, and for other parts of the Sewerage Works, exclusive of the engineers and day-labor forces, has upon the average numbered 167.

The whole regular force of the Sewerage Department at the end of the year numbered 184, of whom the Engineer and 16 assistants and draftsmen were engaged in general upon the works, and of the remainder, 104 were employed upon the North System and 63 upon the South System.

The maximum number of men employed upon contracts and upon day-labor construction on the Sewerage Works during the year was for the week ending August 13, when the number amounted to 175.

II. METROPOLITAN WATER DISTRICT.

The Metropolitan Water District now comprises the cities of Boston, Chelsea, Everett, Malden, Medford, Melrose, Newton, Quincy and Somerville, and the towns of Arlington, Belmont, Lexington, Milton, Nahant, Revere, Stoneham, Swampscott, Watertown and Winthrop, — in all 9 cities and 10 towns. The District has an area of 174.8 square miles, no additional municipalities having been admitted into the District during the year. Its population, according to the United States Census taken for April 1, 1910, was 1,070,256. The population of the District on July 1, 1913, the date upon which calculations for the Water Works are based, was estimated as 1,152,490.

III. METROPOLITAN WATER WORKS — CONSTRUCTION.

The total amount expended for the construction and acquisition of the Metropolitan Water Works since the passage of the Metropolitan Water Act in the year 1895 has been $42,236,743.53.

The total amount expended during the calendar year on account of the construction and acquisition of works has been $200,431.56. The details of this expenditure are as follows: on account of the acquisition of Fisher Hill Reservoir and main water pipes of the city of Boston, the sum of $150,000; for the preliminary work on lowering water pipes in Chelsea Creek, $1,970.51; balance on account of the new pumping engine which has been installed at the Chestnut Hill pumping station for the southern high-service district, $2,182.61; for the laying of a new main to Hyde Park, and on account of the construction of the new pumping station, the sum of $32,338.55;

for stock on hand, $10,293.44; and for other minor works, engineering and administration expenses, the sum of $3,646.45.

The new pumping station on Hyde Park Avenue in the Hyde Park district of the city of Boston was completed and put in service in January, 1913, and the use of the West Roxbury pumping station, which is owned by the city of Boston and has been operated under an arrangement with the city, was discontinued on that date.

The acquisition by the Board of Fisher Hill Reservoir and the large mains previously owned and used by the city of Boston for the purpose of conveying water through the town of Brookline and the city of Somerville into its own limits, was authorized by chapter 694 of the Acts of the year 1912, and the sum of $600,000 was appropriated for the purpose. A taking of the property was made on August 20, 1913, and the sum of $150,000 has been paid in full settlement therefor.

In order to permit the dredging of the channel of Chelsea Creek, for which Congress has appropriated the sum of $85,000, the Legislature, by chapter 755 of the Acts of the year 1913, authorized the Board to expend the sum of $75,000 for the purpose of lowering the water mains now laid across the creek between Chelsea and East Boston so far as necessary to secure a channel depth of 25 feet below mean low water. Plans have been prepared for the construction of a tunnel between vertical shafts, through which a water pipe is to be carried across the creek channel at a depth sufficient to permit the dredging of a channel 35 feet deep at mean low water. The plans have received the approval of the Directors of the Port of Boston, and work will be begun as soon as the approval of the Secretary of War is received.

The Legislature, by chapter 814 of the Acts of the year 1913, authorized the Board to widen, straighten and deepen Beaver Dam Brook in the towns of Ashland, Framingham, Sherborn and Natick, and appropriated $33,000 for the work, one-third of that sum to be repaid by the town of Framingham. Tentative plans have been prepared, subject to the examination and approval of the authorities of the town of Framingham.

On August 1, 1911, the city of Worcester diverted for its own use the water from Asnebumskit and Kendall brooks and the Kendall Reservoir in the town of Holden. This action of the city was taken under chapter 351 of the Acts of the year 1902, and by the taking the city acquired the right to divert the water from 9.35 square miles of watershed which had been tributary to the Wachusett watershed and Reservoir. During the past year the city of Worcester has practically completed the construction of the Kendall Reservoir and Dam, and the whole flow of the brook has been diverted into this reservoir since about July 1. The question of the amount to be paid by the city to this Board, in payment for the water rights taken, has been considered by the City Engineer of Worcester and the Chief Engineer of the Metropolitan Water Works, acting as arbitrators under the terms of the legislative act, but a decision has not yet been reached.

During the year 12.394 acres of land in fee and easements in 3.988 acres were acquired for the Water Works.

IV. WATER WORKS — MAINTENANCE.

The maintenance and operation of the Metropolitan Water Works during the past calendar year have required the expenditure of $437,869.82.

(1) Storage Reservoirs.

On April 30 the water in the Wachusett Reservoir reached high-water mark, elevation 395. Stop-planks were placed on the waste-way and the reservoir allowed to rise above high-water mark, the maximum elevation of 395.38 being reached on May 31.

The Sudbury Reservoir, Framingham Reservoir No. 3 and Lake Cochituate, from which reservoirs water is discharged into the Weston, Sudbury and Cochituate aqueducts, have been kept nearly full during the year.

It has not been necessary to draw water for the supply of the Metropolitan District from Framingham Reservoir No. 1, Framingham Reservoir No. 2, Farm Pond, Ashland, Hopkinton and Whitehall reservoirs, but water has been discharged from Framingham Reservoir No. 1 and Framingham Reservoir No. 2 into Farm Pond, from which the town of Framingham obtains indirectly most of its supply.

(2) Aqueducts.

The Wachusett Aqueduct was in service for the passage of water from the Wachusett Reservoir to the Sudbury Reservoir during the whole or portions of 288 days. The quantity of water flowing through the aqueduct was equal to an average of 84,997,000 gallons per day for the entire year, 92 per cent. being used before its admission into the aqueduct for the development of electric energy.

For distribution to the cities and towns of the Metropolitan Water District water was drawn through the Sudbury Aqueduct to the Chestnut Hill Reservoir during portions of 364 days, the daily average for the whole year being 64,624,000 gallons.

The Weston Aqueduct was in use during most of the year, the quantity of water delivered through the aqueduct being equivalent to a daily average of 35,943,000 gallons.

The Cochituate Aqueduct was used during a portion of the year, the quantity of water conveyed from Lake Cochituate to Chestnut Hill Reservoir being equivalent to a daily average of 2,425,000 gallons.

(3) PUMPING STATIONS.

During the year 67 per cent. of the water furnished for distribution to the Metropolitan Water District was pumped at the two Chestnut Hill stations. The remaining 33 per cent. of the water was distributed by gravity, this proportion being 2 per cent. greater than that of 1912. Other pumping at the Spot Pond, Arlington and Hyde Park pumping stations has been required for supplying the higher portions of the District.

The average quantity pumped per day at the Chestnut Hill stations was 69,950,000 gallons, at the Spot Pond station 7,126,000 gallons, at the Arlington station 678,000 gallons and at the Hyde Park station 802,000 gallons, a total of 78,556,000 gallons per day.

The following are the several pumping stations: —

	Number of Engines.	Contract Capacity per Day (Gallons).	Lift (Feet).
Chestnut Hill High-service station,	4	66,000,000	138
Chestnut Hill Low-service station,	3	105,000,000	60
Chestnut Hill Low-service station,	1	40,000,000	130
Spot Pond station,	2	30,000,000	125
Arlington station,	2	3,000,000	290
Hyde Park station,	2	6,000,000	140

The cost of operating the stations was $98,166.39, equivalent to $3.424 per million gallons pumped. The total cost is considerably less than for the year 1912, but the cost per million gallons shows an increase of $0.226, owing to a reduction in the amount pumped.

The total amount of coal purchased during the year was 8,788.59 gross tons, of which 7,327.08 tons were bituminous and 1,461.51 tons anthracite. Nearly all of the anthracite coal was buckwheat and screenings. The cost of bituminous coal delivered in the bins at the various stations varied from $3.87 to $5.15, and the cost of anthracite coal varied from $2.50 to $3.09 per ton.

(4) Pipe Lines.

During the year the Board acquired from the city of Boston 14.41 miles of large pipes, nearly all of which are in the city of Somerville and the town of Brookline, making the total length of pipes controlled and operated by the Board on December 31, 116.10 miles. The local mains of 4 inches and more in diameter, with which the Metropolitan mains are connected for the distribution of water to the various municipalities in the District, have a total length of 1,779.01 miles.

There were 56 leaks and 3 breaks in the mains during the year, the only serious break occurring on December 4 in the 48-inch main at the junction of Clinton and Dean roads in Brookline. The pipe in which this break occurred was laid by the city of Boston in 1869. A piece of pipe containing 31.6 square feet in area was blown out and water flowed from the opening for nearly two hours at the rate of about 80,000,000 gallons per day, washing away the surface of the streets and causing damage to lawns and houses. The repairing of the pipe was done by the maintenance force, and it will be necessary to reseed some of the lawns and relay some of the walks during the coming year.

The work of relaying a portion of the 16-inch water main used in supplying the towns of Nahant and Swampscott, where it crosses the Saugus River between Saugus and Lynn, was completed on June 25. The main is now supported on a concrete shelf, in connection with the new bridge, for a distance of 200 feet. The expense of the changes in the main made necessary by the rebuilding of Fox Hill bridge, and imposed by statute upon the Metropolitan Water District, is $6,548.56.

The two 36-inch mains laid under the bed of the Charles River between Cambridge and Boston having deteriorated by electrolytic action, it was decided to remove them from the river bed and carry them over the river on the Anderson masonry arch bridge now under construction. A portion of the work has been done, the amount expended to December 31 being $4,951.49.

(5) PROTECTION OF THE WATER SUPPLY.

The Marlborough Brook filter-beds, on which is filtered the water received from brooks passing through the thickly settled portions of Marlborough, have been adequate for the filtration of all the water received.

The Pegan Brook pumping station, at which is pumped upon the filter-beds the surface drainage of about one square mile in the thickly settled portion of Natick, was in operation 226 days in the year.

The filter-beds which receive for filtration the water flowing through the thickly settled portion of the town of Sterling, as well as the smaller filter-beds which receive the drainage from a few houses near Sterling Junction, the Worcester County Training School at West Boylston and from the swimming pool at Southborough, have been in successful operation and required only the usual attention during the year.

Studies for the disposal of manufacturing wastes, as well as for the disposal of house drainage from the various towns within the drainage area of the Metropolitan Water System, have been in progress during the year.

Constant inspection of the watersheds is maintained by the Sanitary Inspector and his assistants and members of the maintenance force.

Chemical examinations of the waters used were made by the State Board of Health, and there were in addition microscopical and bacterial examinations made by this Board. These examinations enable the Board to take measures to remedy any difficulties which are found to exist.

The high quality of the water which has been supplied to the Metropolitan Water District has been maintained, and the results of the chemical and bacterial examinations compare favorably with those of previous years.

(6) FORESTRY.

During the past ten years about 1,500,000 white pine and spruce seedlings have been planted on 1,313 acres of land owned by the Board in the vicinity of the Wachusett Reservoir, and there remain 600 acres on the Wachusett watershed to be planted. It is also planned to plant pines on about 800 acres of land in the vicinity of the reservoirs on the Sudbury River watershed. The wooded areas upon the watersheds have received the attention necessary to preserve and improve the growth already in existence there.

The ravages of the gypsy and brown-tail moths and of the elm-leaf beetle have continued during the year, requiring a large amount of work and considerable expense to protect the trees on lands controlled by the Board. The egg clusters of the gypsy moth have been painted with creosote and nests of the brown-tail moths destroyed by burning, and extensive spraying has been required for the preservation of trees infested by moths and elm-leaf beetles.

(7) WACHUSETT POWER PLANT.

The hydro-electric power station at the Wachusett Dam has been in active operation 276 days, and for a portion of the time power has been furnished in excess of the minimum amount required by the contract with the Connecticut River Transmission Company. The operation of the plant has been entirely successful, the gross earnings for the year being $33,096.27. The cost of operating the plant has been $8,989.75, the net earnings $24,106.52 and the net earnings per thousand kilowatt hours generated, $3.87.

(8) RAINFALL AND WATER SUPPLY.

The rainfall is still below the average, though somewhat larger than in the preceding year. On the Wachusett watershed the rainfall was 41.22 inches and on the Sudbury watershed 44.31 inches, while the averages for the periods covered by the records have been, respectively, 45.84 inches and 44.99 inches.

The Wachusett watershed yielded a daily average of 879,000 gallons of water per square mile, and the Sudbury watershed yielded a daily average of 733,000 gallons. The Wachusett watershed yielded a daily average of 1,081,000 gallons, per square mile, for the 17 years during which measurements have been made, and the daily average per square mile from the Sudbury watershed during the 38 years for which records have been kept has been 1,000,000 gallons.

(9) Water Consumption.

During the year the quantity of water supplied to the Metropolitan Water District amounted to a daily average of 103,847,700 gallons, which was equivalent to 94 gallons for each person in the District. This quantity was 12,383,000 gallons less than the average daily consumption of the preceding year. This decrease is largely due to the more general use of meters and the unusually warm weather during the winter of 1912–1913.

Acting under the authority conferred by several statutes and arrangements which have been made, water has been supplied to a limited extent outside of the Metropolitan Water District. There has been drawn from the open channel of the Wachusett Aqueduct for the use of the Westborough State Hospital an average daily quantity of 167,000 gallons. The town of Framingham has, under the provision of the statute, drawn indirectly from Farm Pond an average daily quantity of 756,984 gallons and directly from the Sudbury Aqueduct 18,356 gallons. A portion of the town of Saugus has been supplied through the town of Revere with an average of 13,000 gallons daily, and the United States Government, for use on Peddock's Island, has been supplied with a daily average of 102,100 gallons. The sums charged for the water thus supplied have amounted to $5,134.39.

V. WATER WORKS — FINANCIAL STATEMENT.

The financial abstract of the receipts, disbursements, assets and liabilities of the Board for the State fiscal year, beginning with December 1, 1912, and ending with November 30, 1913, was, in accordance with the requirements of chapter 235 of the Acts of the year 1906, presented to the General Court in January last, and a copy of this financial abstract is printed as Appendix No. 5.

As required by said chapter a detailed statement of its doings for the calendar year 1913 in relation to the Metropolitan Water Works, is herewith presented.

Construction.

(1) Water Loans — Receipts and Payments.

Loans authorized under acts prior to 1913,		$42,690,000 00
Loans authorized under acts of 1913: —		
Chapter 814, Improvement of Beaver Dam Brook,		33,000 00
Chapter 755, Lowering Water Mains in Chelsea Creek,		75,000 00
Total loans authorized to January 1, 1914,		$42,798.000 00
Receipts from the sales of property applicable to the construction and acquisition of works: —		
Receipts prior to January 1, 1913,	$220,836 14	
Receipts for year ending December 31, 1913,	13,341 60	
		234,177 74
Receipt from town of Swampscott for admission to District (St. 1909, c. 320),		90,000 00
Total amount authorized to January 1, 1914,		$43,122,177 74
Amounts approved by Board for payments out of Water Loan Fund: —		
Payments prior to January 1, 1913,	$42,036,311 97	
Approved for year ending December 31, 1913,	200,431 56	
		42,236,743 53
Amount authorized but not expended January 1, 1914,		$885,434 21

(2) Total Water Debt December 31, 1913.

Water Loan Outstanding, Sinking Fund and Debt.

Bonds issued by the Treasurer of the Commonwealth: —		
Sinking fund bonds (3 and 3½ per cent.),		$41,398,000 00
Serial bonds (3½ per cent.),		390,000 00
Total bond issue to December 31, 1913,		$41,788,000 00
Serial bonds paid prior to January 1, 1913,	$5,000 00	
Serial bonds paid in 1913,	10.000 00	
		15,000 00
Total bond issue outstanding December 31, 1913,		$41,773,000 00
Temporary Loan September, 1913,		150,000 00
Gross Water Debt,		$41,923,000 00
Sinking fund December 31, 1913,		10,767,701 68
Net Water Debt December 31, 1913,		$31,155,298 32

A decrease for the year of $798,344.88.

(3) METROPOLITAN WATER LOAN AND SINKING FUND, DECEMBER 31, 1913.

YEAR.	Authorised Loans.	Bonds issued (Sinking Fund).	Bonds issued (Serial Bonds).	Sinking Fund.
1895,	$27,000,000	$5,000,000	-	$226,286 05
1896,	-	2,000,000	-	699,860 70
1897,	-	6,000,000	-	954,469 00
1898,	-	4,000,000	-	1,416,374 29
1899,	-	3,000,000	-	1,349,332 97
1900,	-	1,000,000	-	1,573,619 72
1901,	13,000,000	10,000,000	-	1,662,426 95
1902,	-	3,500,000	-	2,256,803 81
1903,	-	1,500,000	-	2,877,835 59
1904,	-	2,500,000	-	3,519,602 92
1905,	-	650,000	-	4,207,045 69
1906,	500,000	1,350,000	-	4,897,822 62
1907,	-	-	-	5,643,575 69
1908,	398,000	-	-	6,419,283 28
1909,	900,000	398,000	-	7,226,262 31
1910,	80,000	500,000	-	8,089,902 91
1911,	212,000	-	$200,000	8,953,437 44
1912,	600,000	-	190,000	9,829,356 80
1913,	108,000	-	-	10,767,701 68
	$42,798,000	$41,398,000	$390,000	

(4) WATER ASSESSMENT, 1913.

The following water assessment was made by the Treasurer of the Commonwealth upon the various municipalities: —

Sinking fund requirements,		$506,812 00
Serial bonds,		10,000 00
Interest,		1,427,208 96
Maintenance: —		
Appropriated by Legislature,	$447,000 00	
Less balance on hand,	26,376 36	
		420,623 64
Total water assessment for 1913,		$2,364,644 60

In accordance with chapter 488, Acts of 1895, as amended in 1901, 1904 and 1906, the proportion to be paid by each city and town is based one-third in proportion to their respective valuations and the remaining two-thirds in proportion to their respective water consumption for the preceding year, except that but one-fifth of the total valuation and no consumption has been taken for the city of Newton, as it has not been supplied with water from the Metropolitan works.

The division of the assessment for 1913 was as follows: —

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Arlington,	$20,491 56	Nahant,	$6,181 89
Belmont,	9,042 70	Newton,	6,680 74
Boston,	1,842,127 65	Quincy,	55,519 02
Chelsea,	51,547 66	Revere,	28,587 67
Everett,	49,124 16	Somerville,	116,320 88
Lexington,	8,267 34	Stoneham,	10,213 41
Malden,	47,126 88	Swampscott,	11,254 35
Medford,	27,916 12	Watertown,	19,245 16
Melrose,	22,684 86	Winthrop,	15,909 87
Milton,	16,402 68		$2,364,644 60

(5) SUPPLYING WATER TO CITIES AND TOWNS OUTSIDE OF DISTRICT AND TO WATER COMPANIES.

Sums have been received during the year 1913 under the provisions of the Metropolitan Water Act, for water furnished, as follows: —

Town of Framingham,	$829 98
Town of Revere (on account of water furnished to a portion of the town of Saugus for 1912),	340 00
United States Government (for Peddock's Island),	2,366 56
Westborough State Hospital,	1,810 56
The Snare & Triest Company,	40 27
	$5,387 37

The sums so received prior to March 23, 1907, were annually distributed among the cities and towns of the District, but since that date, in accordance with the provisions of chapter 238 of the Acts of 1907, the sums so received have been paid into the sinking fund.

(6) EXPENDITURES FOR THE DIFFERENT WORKS.

The following is a summary of the expenditures made in the various operations for the different works: —

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1913.	
Administration applicable to all parts of the construction and acquisition of the works,		$2,875 92
Wachusett Department real estate,		8 92
Beaver Dam Brook improvement,		118 59
Distribution system: —		
Low service: —		
Pipe lines and connections,	$190 39	
Lowering pipe at Chelsea Creek,	1,970 51	
Southern high service: —		
Pipe lines and connections,	10 78	
Section 39 (Hyde Park connection),	1,553 49	
Pumping station, Chestnut Hill,	2,182 61	
Southern extra high service: —		
Hyde Park connection: —		
Section 40,	571 73	
Section 41,	818 06	
Hyde Park Pumping Station,	29,395 27	
Weston Aqueduct supply mains,	416 85	
		37,109 69
Stock — pipes, valves, castings, etc., purchased and sent first to storage yards, and later transferred, as needed, to the various parts of the work: —		
Amount received,	$12,386 34	
Transferred from storage yards to the various sections of the work and included in costs of special works,	2,092 90	
		10,293 44
Acquisition of existing water works, city of Boston,	$150,000 00	
Legal and expert expenses,	25 00	
		150,025 00
		$200,431 56
Amount charged from beginning of work to January 1, 1913,		42,036,311 97
Total for construction and acquisition of works to January 1, 1914,		$42,236,743 53

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1913.	
Administration,		$15,830 80
General supervision,		34,870 50
Taxes and other expenses,		40,114 63
Wachusett Department: —		
Superintendence,	$10,190 79	
Reservoir,	8,487 04	
Forestry,	16,285 23	
Protection of supply,	2,761 05	
Buildings and grounds,	6,004 33	
Wachusett Dam,	4,256 15	
Wachusett Aqueduct,	3,928 43	
Clinton sewerage system: —		
Pumping station,	2,031 38	
Electric plant,	1,034 12	
Sewers, screens and filter-beds,	3,972 65	
Sanitary inspection,	1,281 71	
Swamp drainage,	3,226 11	
Power plant,	6,014 75	
		69,473 74
Sudbury Department: —		
Superintendence, Framingham office,	$11,151 44	
Ashland Reservoir,	1,567 14	
Hopkinton Reservoir,	1,645 23	
Whitehall Reservoir,	744 35	
Framingham Reservoirs Nos. 1, 2 and 3,	6,934 79	
Sudbury Reservoir,	7,850 09	
Lake Cochituate,	4,776 88	
Marlborough Brook filters,	2,439 99	
Pegan filters,	3,454 95	
Sudbury and Cochituate watersheds,	2,361 23	
Sanitary inspection,	3,624 50	
Cochituate Aqueduct,	4,153 59	
Sudbury Aqueduct,	6,831 93	
Weston Aqueduct,	5,843 04	
Improving Lake Cochituate,	1,117 12	
Forestry,	4,122 03	
Improvement and protection of water supplies,	3,204 58	
Protection of water supply in aqueducts,	4,990 61	
		76,813 49
Distribution Department: —		
Superintendence,	$4,395 19	
Arlington pumping station, pumping service,	8,370 16	
Chestnut Hill Low-service pumping station, pumping service,	49,227 94	
Chestnut Hill High-service pumping station, pumping service,	21,801 00	
Spot Pond pumping station, pumping service,	15,180 12	
West Roxbury pumping station, pumping service,	1,605 29	
Hyde Park pumping station, pumping service,	7,646 73	
Arlington standpipe,	85 22	
Bear Hill Reservoir,	283 93	
Amounts carried forward,	$108,595 58	$237,103 16

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1913.	
Amounts brought forward,	$108,595 58	$237,103 16
Distribution Department — *Con.*		
Chestnut Hill Reservoir and grounds,	9,911 92	
Fells Reservoir,	602 94	
Forbes Hill Reservoir,	1,083 03	
Mystic Lake, conduit and pumping station,	1,447 74	
Mystic Reservoir,	1,089 01	
Waban Hill Reservoir,	234 54	
Weston Reservoir,	2,695 73	
Spot Pond,	7,418 01	
Buildings at Spot Pond,	746 07	
Pipe lines: —		
Low service,	29,653 12	
Northern high service,	7,600 01	
Northern extra high service,	181 28	
Southern high service,	5,518 82	
Southern extra high service,	481 89	
Supply pipe lines,	1,737 05	
Buildings at Chestnut Hill Reservoir,	5,499 45	
Chestnut Hill pipe yard,	1,594 69	
Glenwood pipe yard and buildings,	3,745 52	
Stables,	7,284 19	
Venturi meters,	865 33	
Measurement of water,	1,574 82	
Arlington pumping station, buildings and grounds,	351 94	
Hyde Park pumping station, buildings and grounds,	135 81	
Fisher Hill Reservoir,	768 17	200,766 66
Total for maintaining and operating works,		$437,869 82

(7) DETAILED FINANCIAL STATEMENT UNDER METROPOLITAN WATER ACT.

The Board herewith presents, in accordance with the requirements of the Metropolitan Water Act, a detailed statement of the expenditures and disbursements, receipts, assets and liabilities for the year 1913.

(*a*) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1913, and ending December 31, 1913, is $200,431.56, and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1913, is $42,236,743.53.

For maintenance and operation the expenditures for the year were $437,869.82.

The salaries of the commissioners, and the other expenses of administration, have been apportioned to the construction of the works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character: —

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1913.	
CONSTRUCTION OF WORKS AND ACQUISITION BY PURCHASE OR TAKING.		
Administration.		
Commissioners,	$791 67	
Secretary and auditor,	750 00	
Clerks and stenographers,	745 83	
Traveling,	25 00	
Stationery and printing,	234 46	
Postage, express and telegrams,	30 00	
Telephone, lighting, heating, water and care of building,	140 98	
Rent and taxes, main office,	128 69	
Miscellaneous expenses,	29 30	
		$2,875 93
Engineering.		
Chief engineer and department engineers,	$128 21	
Principal assistant engineers,	1,056 22	
Engineering assistants,	1,813 52	
Inspectors,	180 00	
Architects,	25 00	
Railroad and street car travel,	10 56	
Engineering and drafting supplies,	11 50	
Telephone, lighting, heating, water and care of buildings: —		
Main office,	423 06	
Sub-offices,	17 98	
Rent and taxes, main office,	386 10	
Miscellaneous expenses,	15 40	
		4,067 55
Construction.		
Preliminary work, advertising,		5 40
Contracts, Distribution System: —		
T. H. Corrigan, for furnishing and placing loam at the Hyde Park Pumping Station,	$2,810 60	
Florence Iron Works, cast-iron water pipes and special castings,	12,115 34	
Holly Manufacturing Co., high-service pumping engine at Chestnut Hill,	1,769 00	
A. Varnerin Co., for building the superstructure of Hyde Park pumping station,	3,630 50	
Amounts carried forward,	$20,325 44	$6,948 88

General Character of Expenditures.	For the Year ending December 31, 1913.	
Amounts brought forward,	$20,325 44	$6,948 88
Construction — Con.		
Contracts, Distribution System — *Con.*		
Warren Brothers Co., for constructing artificial stone walks at Hyde Park pumping station,	475 00	
Laidlaw-Dunn-Gordon Co., for furnishing two pumping engines for Hyde Park pumping station,	11,683 20	
		$32,483 64
Additional work: —		
Labor,	$4,288 36	
Freight and express,	104 12	
Jobbing and repairing,	12 00	
Tools, machinery, appliances and hardware supplies,	1,280 41	
Electrical supplies,	513 68	
Castings, ironwork and metals,	1,139 38	
Iron pipe and valves,	1,213 91	
Paint and coating,	93 00	
Lumber and field buildings,	78 76	
Drain pipe,	8 00	
Brick, cement and stone,	1,240 99	
Sand, gravel and filling,	137 66	
Unclassified supplies,	264 70	
Miscellaneous expenses,	193 73	
		10,568 70
Real Estate.		
Legal and expert: —		
Conveyancer and assistants,	$2 00	
Conveyancing supplies,	7 00	
Settlements made by Board,	171 34	
Judgments,	225 00	
		405 34
Purchase of Existing Water Works.		
Legal and expert services,	$25 00	
Settlement,	150,000 00	
		150,025 00
		$200,431 56
Amount charged from beginning of work to January 1, 1913,		42,036,311 97
Total amount of construction expenditures to January 1, 1914,		$42,236,743 53

General Character of Expenditures.	For the Year ending December 31, 1913.	
Maintenance and Operation of Works.		
Administration: —		
Commissioners,	$5,200 32	
Secretary and assistants,	7,486 82	
Rent,	614 88	
Repairs of building,	5 27	
Fuel,	47 75	
Lighting,	44 40	
Care of building,	454 63	
Postage,	188 50	
Printing, stationery and office supplies,	1,371 84	
Telephones,	104 41	
Traveling expenses,	112 32	
Miscellaneous expenses,	199 66	
		$15,830 80
General supervision: —		
Chief engineer and assistants,	$27,862 73	
Rent,	1,844 70	
Repairs of building,	238 21	
Fuel,	143 28	
Lighting,	133 20	
Care of building,	1,364 17	
Postage,	106 00	
Printing, stationery and office supplies,	871 65	
Telephones,	432 46	
Traveling expenses,	596 34	
Miscellaneous expenses,	1,277 76	$34,870 50
Pumping service: —		
Labor,	$62,400 87	
Fuel,	35,303 60	
Oil, waste and packing,	1,371 96	
Repairs,	2,740 04	
Small supplies,	1,239 72	
Rent,	775 05	
		$103,831 24
Reservoirs, aqueducts, pipe lines, buildings and grounds: —		
Superintendents,	$7,175 00	
Engineering assistants,	11,027 52	
Sanitary inspectors,	3,354 55	
Labor, pay roll,	150,411 61	
Labor, miscellaneous,	7,517 85	
Alterations and repairs of pumping stations,	4,582 38	
Alterations and repairs of other buildings and structures,	1,663 72	
Automobiles,	10,325 81	
Brick,	411 10	
Amounts carried forward,	$196,469 54	$154,532 54

General Character of Expenditures.	For the Year ending December 31, 1913.	
Amounts brought forward,	$198,469 54	$154,532 54
Reservoirs, aqueducts, pipe lines, buildings and grounds — *Con.*		
Brooms, brushes and janitor's supplies,	243 31	
Castings, ironwork and metals,	9,620 81	
Cement and lime,	763 34	
Drafting and photo supplies,	144 93	
Fertilizer and planting material,	1,184 69	
Freight and express,	628 16	
Fuel,	2,168 36	
Gypsy moth supplies,	2,502 46	
Hardware,	1,175 91	
Hay and grain,	2,031 66	
Lighting,	238 94	
Lumber,	4,063 21	
Machinery,	772 74	
Paints and oils,	1,344 78	
Pipe and fittings,	1,822 85	
Postage,	110 71	
Printing, stationery and office supplies,	642 03	
Rubber and oiled goods,	1,088 33	
Stable expenses,	704 67	
Sand, gravel and stone,	818 70	
Traveling expenses,	2,486 34	
Telephones,	1,065 13	
Teaming,	364 60	
Tools and appliances,	1,669 23	
Vehicles, harnesses and fittings,	444 23	
Miscellaneous expenses,	6,296 89	
Contracts: —		
The W. P. Leavitt Sons Co., repairing roof of lower gate-house at Wachusett Dam, contract 30-M,	1,100 00	
Power Equipment Co., electric motor and centrifugal pump for the Clinton Sewerage pumping station, contract 25-M,	966 09	
		245,222 65
Payments in lieu of taxes,		40,114 63
Total expenditures for maintenance and operation,		$439,869 82

(b) *Receipts.*

The total amount of receipts from the operations of the Board and from sales of property for the year beginning January 1, 1913, and ending December 31, 1913, is $67,081.88 and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1913, is $941,731.69. The general character of these receipts is as follows: —

General Character of Receipts.	For the Year ending December 31, 1913.	
Applicable to the loan fund: —		
Land and buildings,	$27 00	
Construction tools, supplies and reimbursements,	13,314 60	
		$13,341 60
Applicable to payment of interest, sinking fund requirements and expenses of maintenance and operation: —		
Proceeds from operations of the Board: —		
Rents (from February 1, 1913),	$1,586 83	
Land products (from February 1, 1913),	8,027 06	
Electric energy,	31,704 44	
Maintenance labor, tools, supplies and reimbursements,	6,449 62	
Interest and unclassified receipts (from February 1, 1913),	115 75	
		47,883 70
Applicable to the sinking fund: —		
Water supplied to cities and towns, water companies and others (from March 22, 1907),	$5,387 37	
Rents (prior to February 1, 1913),	298 50	
Land products (prior to February 1, 1913),	164 10	
Unclassified receipts and interest (prior to February 1, 1913),	6 61	
		5,856 58
		$67,081 88
Amount credited from beginning of work to January 1, 1913,	. . . .	874,649 81
Total receipts to January 1, 1914,	. . . .	$941,731 69

The foregoing receipts have been credited to the various objects or works, as follows: —

Sources of Receipts.	For the Year ending December 31, 1913.	
Supplying water outside of Water District,	. . . .	$5,387 37
Construction and acquisition of works: —		
Administration,	$22 90	
Wachusett Dam,	159 85	
Wachusett Reservoir,	172 91	
Wachusett Aqueduct,	2 59	
Weston Aqueduct,	145 14	
Sudbury Reservoir,	39 52	
Distribution system,	12,741 40	
Diversion of water, Clinton sewerage system,	55 19	
Purchase of existing water works,	25 00	
		13,364 50
Amount carried forward,	. . . .	$18,751 87

Sources of Receipts.	For the Year ending December 31, 1913.	
Amount brought forward,		$18,751 87
Maintenance and operation of works: —		
Administration,	$108 67	
General supervision,	733 39	
Wachusett Aqueduct,	215 28	
Wachusett Reservoir,	7,429 37	
Electric power plant,	31,775 94	
Sudbury system,	2,367 86	
Distribution system,	5,356 00	
Clinton sewerage system,	343 50	
		48,330 01
		$67,081 88
Amount credited from beginning of work to January 1, 1913,		874,649 81
Total receipts to January 1, 1914,		$941,731 69

(c) *Assets.*

The following is an abstract of the assets of the Water Works, a complete schedule of which is kept on file in the office of the Board: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; police supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate and buildings connected therewith.

(d) *Liabilities.*

The sums due on monthly pay rolls amount to $1,443.73, and there are bills for current expenses which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

Name.	Work.	Amount.
McBride & Co.,	Contract 283, Stillwater improvement, Wachusett Reservoir.	$778 09[1]
Camoia & Williams,	Contract 308, Section 33 of northern high-service pipe lines, Distribution System.	200 00
De Vincenzi & Baruffoldi,	Contract 322, Section 36 of northern extra high-service pipe lines, Distribution System.	100 00
Joseph Hanreddy,	Contract 314, Section 7 of the Weston Aqueduct Supply Mains.	10 00
Laidlaw-Dunn-Gordon Co.,	Contract 346, for furnishing two pumping engines for the southern extra high-service pumping station at Hyde Park, Boston, Mass.	1,725 50

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[1] Held pending settlement of claims on account of this contract.

Claims have been made by the following parties for land taken and other damages, and suits are now pending in court for the determination of many of them: —

Patrick Bradley, Henry F. Keyes, James E. Welch, Byron D. Allen, J. Frank Wood *et al.*, Asa Knight, Edward F. Merriam, Sanford C. Kendall, estate of William H. Vickery, James H. and Hannah S. Wood, Francis W. M. Goodale, John Ward *et al.*, heirs of George K. Ward.

VI. METROPOLITAN SEWERAGE WORKS.

The North Metropolitan Sewerage District embraces the cities of Cambridge, Chelsea, Everett, Malden, Medford, Melrose, Somerville and Woburn, and the towns of Arlington, Belmont, Revere, Stoneham, Wakefield, Winchester and Winthrop, and parts of the city of Boston and the town of Lexington, — comprising in all 9 cities and 8 towns, with an area of 90.50 square miles. The district has an estimated population, based upon the United States Census of 1910, as of December 31, 1913, of 570,490. Of the total population it is estimated that 89.4 per cent., or 510,040 people, contribute sewage to the North Metropolitan System.

The South Metropolitan Sewerage District includes the cities of Newton, Quincy and Waltham, and the towns of Brookline, Milton and Watertown, and parts of the city of Boston and the town of Dedham, — a total of 4 cities and 4 towns. This district has an area of 100.87 square miles, with an estimated population as of December 31, 1913, of 393,390. According to the estimates made 66.9 per cent. of this population, or 262,990, contribute sewage to the South Metropolitan System.

(1) NORTH METROPOLITAN SEWERAGE SYSTEM — CONSTRUCTION.

The amount expended for construction on account of the North Metropolitan System during the past year was $223,567.76.

The construction of the new Mystic sewer, authorized by the Legislature of 1912, has been in progress during the year. Section 67 has been completed. Contracts for constructing Sections 68, 69 and 70 have been awarded and, with the exception of Section 69, are nearly completed. The masonry work on Section 68 was completed in December, and there only remains a small amount of grading and surfacing to finish the work on this section. The contract for Section 69 was let on December 31, and the work will be prosecuted during the coming year. On Section 70 about 300 feet remain to be constructed. The construction of these sections will complete the sewer authorized by the Legislature.

The addition to the screen-house of the East Boston pumping station has been completed and one set of screens installed. The work of changing the old screen-chamber to fit the new conditions is now in progress, and the remaining set of screens will be in operation early in the coming year.

The Legislature, by chapter 377 of the Acts of the year 1913, authorized the construction of an additional sewer in Boston Avenue, Somerville, for the purpose of conveying the sewage from a part of Medford across a small portion of Somerville. No appropriation was made for this work as there was sufficient balance in construction funds to cover the expense. The work has been completed and the sewer placed in service.

Arrangements were made early in the year with the President and Fellows of Harvard College to relocate and construct a portion of Section 30 of the North Metropolitan System. The proposed location of certain dormitories for the use of the college included land through which the sewer had been originally constructed, and in order to relocate the same so that there would be no interference either with the sewer or buildings, a new location was selected and the sewer rebuilt accordingly, the expense of the relocation and construction being borne by the college authorities.

The Board acquired by taking easements in 2.471 acres of land in Winchester and Woburn for the construction of the new Mystic sewer, and in 0.184 of an acre in Cambridge for the relocation of part of Section 30.

(2) North Metropolitan Sewerage System — Maintenance.

The cost of the maintenance and operation of the North Metropolitan System during the past year has been $170,133.69.

(a) *Sewers and Pumping Stations.*

The Metropolitan sewers in the North Metropolitan System now extend a distance of 62.467 miles, and the local sewers which are connected with the Metropolitan sewers have a further length of 715.69 miles, involving 76,433 connections.

The sewage of the North Metropolitan District flows at first by gravity, but before being finally disposed of is lifted at different points by pumping and is finally discharged into the harbor from an outfall off Deer Island.

The daily average amount of sewage discharged into the harbor was 56,600,000 gallons, a daily average for each person contributing sewage of 111 gallons. The increase in the total amount of sewage discharged was 900,000 gallons per day more than the discharge of the preceding year. The maximum rate of discharge in any one day was 148,700,000 gallons.

The pumping stations operated for the North Metropolitan Sewerage System are as follows: —

	Number of Engines.	Contract Capacity per Day (Gallons).	Lift (Feet).
Deer Island station (Boston harbor),	4	235,000,000	19
East Boston station,	4	235,000,000	19
Charlestown station,	3	104,000,000	11 8
Alewife Brook station (Somerville),	3	22,000,000	13

There were purchased for the operation of the pumping stations 7,525.283 tons of bituminous coal, the average prices of which, at the different stations, varied from $4.15 to $4.69 per gross ton delivered in the bins.

The cost of operating the stations was $113,647.10. The average cost per million gallons of sewage lifted per foot at the several stations was $0.147, an increase of about 9 per cent. over the cost last year, due to the increase in the amount paid for labor.

(b) *Tanneries and Gelatine and Glue Works.*

A portion of the maintenance force has been employed in the oversight and care of the Mystic valley sewers which receive the sewage and waste material discharged from the tanneries and other manufactories in Winchester, Woburn and Stoneham. Under the requirements of the Board all the tanneries and other manufactories have installed settling tanks in which the most objectionable matter is [illegible] [illegible] [illegible] [illegible] are allowed to enter the sewers. The [illegible] [illegible] from the tank for disposal elsewhere [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] SOUTH METROPOLITAN SEWERAGE SYSTEM — MAINTENANCE.

The [illegible] [illegible] [illegible] maintenance [illegible] the South Metropolitan System during the past year has been [illegible] [illegible].

[illegible] [illegible] [illegible] Station.

The Metropolitan sewers of the South Metropolitan System, which comprise [illegible] [illegible] Charles River valley sewer and Neponset River valley sewer, [illegible] [illegible] [illegible] the new High-level sewer and extension, have a total length of [illegible] miles, and with these are connected local sewers having a length of [illegible] miles, involving [illegible] connections.

The pumping stations operated in the South Metropolitan Sewerage System are as follows:—

	Number of Engines.	Total Capacity per Day (Gallons).	Lift (Feet).
Ward Street station, Roxbury District,	[illegible]	[illegible]	45
Quincy station,	[illegible]	[illegible]	[illegible]
Quincy sewerage lifting station,	[illegible]	[illegible]	[illegible]

The sewage of two small districts in Dorchester and Milton, included in the Neponset River valley system, which are too low for sewage to be delivered into the High-level sewer by gravity, is, under an arrangement with the city of Boston, disposed of through the Boston Main Drainage Works at Moon Island. By this arrangement the Board is relieved from the expense of providing extra pumping facilities.

A large part of the sewage of the District is lifted into the High-level sewer at the Ward Street pumping station in Roxbury. Most of the sewage of the city of Quincy is pumped into the High-level sewer at Greenleaf Street near the Quincy pumping station. The entire sewage is screened at the Nut Island screen-house for the purpose of intercepting solid matter, and is thence discharged at the bottom of the harbor from the two outfalls about a mile off from the island.

The daily average amount of sewage thus discharged was 53,020,000 gallons, and the largest rate of discharge in a single day was during a heavy storm when the amount reached 152,000,000 gallons. The increase in the daily average from last year was 4,820,000 gallons. The daily average discharge of sewage for each individual contributing sewage in the district was 202 gallons.

There were 3,118.609 gross tons of bituminous coal purchased at the two pumping stations and screen-house, the average prices of which varied from $4.45 to $4.65 per gross ton delivered in the bins.

The total amount expended for the operation of the stations was $59,134.90.

VII. SEWERAGE WORKS — FINANCIAL STATEMENT.

The financial abstract of the receipts, expenditures, disbursements, assets and liabilities of the Metropolitan Water and Sewerage Board for the fiscal year of the Commonwealth ending with November 30, 1913, was, as stated in connection with the Water Works, presented to the General Court in January, in accordance with the requirements of chapter 235 of the Acts of the year 1906, and a copy of this financial abstract is in part printed as Appendix No. 5.

The following statement of its financial doings, in relation to the Metropolitan Sewerage Works, for the calendar year 1913 is herewith presented, in accordance with the provisions of the act of 1906, as a part of the annual report of the Board.

(1) METROPOLITAN SEWERAGE LOANS, RECEIPTS AND PAYMENTS.

The loans authorized for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of these loans, the expenditures for construction, and the balance available on January 1, 1914, have been as follows: —

North Metropolitan System.

Loans authorized under various acts prior to 1913 for the construction of the North Metropolitan System and its various extensions,		$7,0[illegible] [illegible]
Receipts from sales of real estate and from miscellaneous sources which are placed to the credit of the North Metropolitan System:—		
For the year ending December 31, 1913,	[illegible]	
For the period prior to January 1, 1913,	[illegible] 44 [illegible]	
		[illegible]
		$7,[illegible]145 [illegible]
Amount approved for payment by the Board¹ out of the Metropolitan Sewerage Loan Fund, North System:—		
For the year ending December 31, 1913,	$822,5[illegible] [illegible]	
For the period prior to January 1, 1913,	[illegible]79,196 [illegible]	
		[illegible]
Balance, North Metropolitan System, January 1, 1914,		[illegible]

South Metropolitan System.

Loans authorized under the various acts, applied to the construction of the Charles River valley sewer, Neponset valley sewer, High-level sewer and extension, constituting the South Metropolitan System,			$8,867,046 27
Receipts from pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System:—			
For the year ending December 31, 1913,		$76 75	
For the period prior to January 1, 1913,		14,004 60	
			14,081 35
			$8,881,127 62
Amount approved by the Board¹ for payment out of the Metropolitan Sewerage Loan Fund, South System:—			
On account of the Charles River valley sewer,		$800,046 27	
On account of the Neponset valley sewer,		911,531 46	
On account of the High-level sewer and extension,—			
For the year ending December 31, 1913,	$2,095 76		
For the period prior to January 1, 1913,	7,108,913 67		
		7,111,009 43	
			8,822,587 16
Balance, South Metropolitan System, January 1, 1914,			$58,540 46

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¹ The word "Board" refers to the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board.

(2) NORTH AND SOUTH METROPOLITAN LOAN AND SINKING FUNDS, DECEMBER 31, 1913.

YEAR.	LOANS.		BONDS ISSUED (SINKING FUND).		BONDS ISSUED (SERIAL BONDS).	SINKING FUND.
	North System.	South System.	North System.	South System.	North System.	North and South Systems.
1889, ...	$5,000,000 00	-	-	-	-	-
1890, ...	-	-	$2,200,000	$800,000	-	-
1891, ...	-	-	368,000	-	-	-
1892, ...	-	-	1,053,000	-	-	-
1893, ...	-	-	579,000	-	-	-
1894, ...	500,000 00	-	500,000	-	-	-
1895, ...	300,000 00	$500,000 00	300,000	300,000	-	-
1896, ...	30,000 00	-	30,000	200,000	-	-
1897, ...	85,000 00	300,000 00	80,000	300,000	-	-
1898, ...	215,000 00	35,000 00	220,000	35,000	-	-
1899, ...	-	4,625,000 00	-	1,025,000	-	$361,416 59
1900, ...	265,000 00	10,912 00[1]	265,000	10,912	-	454,520 57
1901, ...	-	40,000 00	-	2,040,000	-	545,668 26
1902, ...	-	-	-	864,000	-	636,084 04
1903, ...	500,000 00	1,000,000 00	500,000	1,736,000	-	754,690 41
1904, ...	-	392,000 00	-	392,000	-	878,557 12
1905, ...	-	-	-	-	-	1,008,724 95
1906, ...	55,000 00	1,175,000 00	55,000	175,000	-	1,146,998 68
1907, ...	-	-	-	300,000	-	1,306,850 30
1908, ...	413,000 00	-	-	700,000	-	1,492,418 98
1909, ...	-	-	300,000	-	-	1,673,784 40
1910, ...	56,000 00	-	113,000	-	-	1,931,741 89
1911, ...	6,000 00	-	-	-	-	2,184,674 98
1912, ...	378,000 00	-	-	-	$62,000	2,458,541 20
1913, ...	-	-	-	-	378,000	2,749,337 90
	$7,803,000 00[2]	$8,077,912 00	-	-	-	
	789,134 27	789,134 27	-	-	-	
	$7,013,865 73	$8,867,046 27	$6,563,000	$8,877,912	$440,000	

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[1] The sum of $10,912 was appropriated to reimburse the town of Watertown for the expense of constructing the Watertown siphon.

[2] Of this amount $789,134.27 was expended for the construction of the Charles River valley sewer which is now included in the South Metropolitan System.

(3) ANNUAL APPROPRIATIONS, RECEIPTS AND EXPENDITURES.

The annual appropriations for the maintenance of the Metropolitan Sewerage Works, the receipts of the Board which are added to the appropriations for maintenance, and the expenditures for maintenance for the year ending December 31, 1913, have been as follows: —

North Metropolitan System.

Appropriation under chapter 352 of the Acts of 1913,	$170,600 00
Receipts from pumping and from other sources,	572 91
	$171,172 91
Amount approved by the Board for payment,	170,133 69
Balance, January 1, 1914,	$1,039 22

South Metropolitan System.

Appropriation under chapter 351 of the Acts of 1913,	$109,460 00
Receipts from pumping and from other sources,	159 28
	$109,619 28
Amount approved by the Board for payment,	101,668 59
Balance, January 1, 1914,	$7,950 69

(4) SEWER ASSESSMENTS, 1913.

The following sewer assessments were made by the Treasurer of the Commonwealth upon the various municipalities: —

North Metropolitan Sewerage System.

Sinking fund requirements,		$117,915 00
Serial bonds,		2,742 40
Interest,		224,314 62
Maintenance: —		
Appropriated by Legislature,	$170,600 00	
Less balance on hand,	1,809 37	
		168,790 63
Total North Metropolitan sewerage assessment,		$513,762 65

South Metropolitan Sewerage System.

Sinking fund requirements,		$73,757 00
Interest,		303,275 28
Maintenance: —		
Appropriated by Legislature,	$109,460 00	
Less balance on hand,	4,491 41	
		104,968 59
Total South Metropolitan sewerage assessment,		$482,000 87

In accordance with the provisions of chapter 369, Acts of 1906, the proportion to be paid by each city and town to meet the interest and sinking fund requirements for each year is based upon their respective taxable valuations, and to meet the cost of maintenance and operation upon their respective populations.

The divisions of the assessments for 1913 were as follows: —

North Metropolitan Sewerage System.

CITIES AND TOWNS.	Assessment.	CITIES AND TOWNS.	Assessment.
Arlington,	$14,547 74	Melrose,	$17,103 24
Belmont,	8,274 66	Revere,	18,396 39
Boston,	85,278 83	Somerville,	69,725 37
Cambridge,	111,944 92	Stoneham,	5,659 41
Chelsea,	28,507 06	Wakefield,	10,751 56
Everett,	30,500 51	Winchester,	13,871 08
Lexington,	4,766 98	Winthrop,	13,830 69
Malden,	42,221 69	Woburn,	12,810 93
Medford,	25,571 59	Total,	$513,762 65

South Metropolitan Sewerage System.

CITIES AND TOWNS.	Assessment.	CITIES AND TOWNS.	Assessment.
Boston,	$222,170 42	Newton,	$61,252 25
Brookline,	98,828 71	Quincy,	29,948 08
Dedham,	11,049 18	Waltham,	26,360 93
Hyde Park,[1]	-	Watertown,	14,958 08
Milton,	22,408 21	Total,	$482,000 87

[1] Included in Boston.

(5) EXPENDITURES FOR THE DIFFERENT WORKS.

The following is a summary of the expenditures made in the various operations for the different works: —

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1913.	
North Metropolitan System.		
North System, enlargement: —		
Administration,	$5,317 90	
East Boston pumping station, extensions and additions,	15,972 03	
New Mystic sewer,	191,251 04	
Saratoga Street culvert, East Boston,	270 68	
Relocation part of section 30, Cambridge,	8,872 13	
Section 48A, Somerville and Medford,	1,828 98	
Section 57A, Revere Extension,	55 00	
		$223,567 76
Amount charged from beginning of work to January 1, 1913,		6,739,995 82
Total for North Metropolitan System to January 1, 1914,		$6,963,563 58
South Metropolitan System.		
High-level sewer,		$1,236 53
High-level sewer extension: —		
Administration,	$721 48	
Section 80, day work, West Roxbury and Brookline,	1 20	
Section 85, Brighton,	136 55	
		859 23
		$2,095 76
Amount charged from beginning of work to January 1, 1913,		8,520,491 40
Total for South Metropolitan System to January 1, 1914,		$8,522,587 16
Total for construction, both systems,		$15,786,150 74

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1913.
North Metropolitan System,	$170,133 69
South Metropolitan System,	101,668 59
Total for maintenance, both systems,	$271,802 28

(6) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Sewerage acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year ending December 31, 1913: —

(a) *Expenditures and Disbursements.*

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1913.	
CONSTRUCTION OF WORKS AND ACQUISITION BY PURCHASE OR TAKING.		
North Metropolitan System.		
Administration: —		
Commissioners,	$2,333 33	
Secretary,	750 00	
Clerks and stenographers,	1,341 00	
Traveling,	11 00	
Stationery, printing and office supplies,	393 28	
Telephone, lighting, heating, water and care of building,	234 79	
Rent and taxes, main office,	214 50	
Miscellaneous expenses,	40 00	
		$5,317 90
Engineering: —		
Chief engineer,	$956 42	
Engineering assistants,	8,302 68	
Inspectors,	5,704 56	
Traveling expenses,	624 64	
Stationery, printing and office supplies,	522 60	
Engineering and drafting instruments and tools,	91 60	
Engineering and drafting supplies,	155 05	
Telephone, lighting, heating, water and care of building,	700 68	
Rent and taxes,	643 50	
Miscellaneous expenses,	546 27	
		18,248 00
Advertising,	$197 63	
Labor and teaming,	5,099 59	
Tools, machinery and appliances,	1,835 64	
Brick, cement, lumber and other field supplies and expenses,	4,831 94	
		11,964 80
Amount carried forward,		$35,530 70

General Character of Expenditures.	For the Year ending December 31, 1913.	
Amount brought forward,	. . .	$35,530 70
North Metropolitan System — Con.		
Contracts: —		
Coleman Brothers, contract 99, for constructing Section 67 (New Mystic sewer) of the North Metropolitan Sewerage System in Medford and Winchester,	$83,821 17	
J. R. Locatelli Co., Inc., contract 100, extension of screen-house for the East Boston pumping station,	4,700 00	
New England Structural Co., contract 101, for furnishing two sets of screens for the East Boston pumping station,	5,842 00	
William J. Barry, contract 102, for building relocation of part of Section 30, Cambridge,	7,754 56	
Ross & Barbaro, contract 103, for constructing Section 70 (New Mystic sewer) of the North Metropolitan Sewerage System in Winchester,	23,637 20	
G. M. Bryne Co., contract 104, for constructing Section 68 (New Mystic sewer) of the North Metropolitan Sewerage System in Winchester,	59,372 05	
Antony Cefalo, contract 105, for constructing Section 48A in Somerville and Medford,	1,397 53	
		186,524 51
Real estate: —		
Legal, conveyancing and expert,	$202 55	
Settlements,	1,310 00	
		1,512 55
Total for North Metropolitan System,	. . .	$223,567 76
South Metropolitan System.		
High-level Sewer.		
Engineering: —		
Engineers, inspectors, rodmen, laborers and others,	$265 00	
Repairs, fittings and supplies, main office,	48 80	
Rent of office, Ashburton Place,	47 73	
Land takings, purchase and recording,	850 00	
Legal services,	25 00	
		$1,236 53
High-level Sewer Extension.		
Administration: —		
Commissioners,	$416 67	
Clerks and stenographers,	185 33	
Stationery, printing and office supplies,	69 58	
Telephone, lighting, heating, water and care of building,	29 24	
Rent and taxes, main office,	16 66	
Miscellaneous expenses,	4 00	
		721 48
Engineering: —		
Telephone, lighting, heating, water and care of building,	$87 75	
Rent and taxes,	50 00	
		137 75
Total for South Metropolitan System,	. . .	$2,095 76

General Character of Expenditures.	For the Year ending December 31, 1913.	
Maintenance and Operation of Works.		
North Metropolitan System.		
Administration: —		
Commissioners,	$2,333 33	
Secretary and assistants,	2,351 99	
Rent,	228 80	
Heating, lighting and care of building,	214 49	
Postage,	58 00	
Printing, stationery and office supplies,	601 32	
Telephones,	41 03	
Traveling expenses,	30 67	
Miscellaneous expenses,	49 78	
		$5,909 41
General supervision: —		
Chief engineer and assistants,	$4,725 89	
Rent,	686 40	
Heating, lighting and care of building,	643 55	
Postage,	20 00	
Printing, stationery and office supplies,	197 63	
Telephones,	123 10	
Traveling expenses,	110 00	
Miscellaneous expenses,	1 86	
		6,508 43
Deer Island pumping station: —		
Labor,	$17,764 26	
Fuel,	13,837 88	
Oil and waste,	512 75	
Water,	1,513 20	
Packing,	183 30	
Repairs and renewals,	1,137 47	
Telephones,	18 30	
General supplies,	991 00	
Miscellaneous supplies and expenses,	49 33	
		36,007 49
East Boston pumping station: —		
Labor,	$23,403 10	
Fuel,	14,046 07	
Oil and waste,	590 58	
Water,	2,163 36	
Packing,	83 82	
Repairs and renewals,	1,463 92	
Telephones,	6 15	
General supplies,	1,519 98	
Miscellaneous supplies and expenses,	48 92	
		43,325 90
Charlestown pumping station: —		
Labor,	$16,659 61	
Fuel,	4,255 12	
Oil and waste,	218 93	
Amounts carried forward,	$21,133 66	$91,751 23

General Character of Expenditures.	For the Year ending December 31, 1913.	
Amounts brought forward,	$21,133 66	$91,751 23
North Metropolitan System — Con.		
Charlestown pumping station — *Con.*		
Water,	589 20	
Packing,	44 91	
Repairs and renewals,	466 39	
Telephones,	48 69	
General supplies,	623 06	
Miscellaneous supplies and expenses,	113 62	
		23,019 53
Alewife Brook pumping station: —		
Labor,	$8,322 25	
Fuel,	2,106 64	
Oil and waste,	226 81	
Water,	207 72	
Packing,	21 86	
Repairs and renewals,	194 34	
Telephones,	39 29	
General supplies,	164 62	
Miscellaneous supplies and expenses,	10 65	
		11,294 18
Sewer lines, buildings and grounds: —		
Engineering assistants,	$3,575 00	
Labor,	30,760 50	
Automobiles,	188 54	
Brick, cement and lime,	250 05	
Castings, ironwork and metals,	1,084 13	
Freight, express and teaming,	2 30	
Fuel and lighting,	25 72	
Jobbing and repairing,	156 12	
Lumber,	887 90	
Machinery, tools and appliances,	514 39	
Paints and oils,	723 92	
Rubber and oiled goods,	429 93	
Sand, gravel and stone,	94 95	
Telephones,	25 60	
Traveling expenses,	470 20	
General supplies,	734 48	
Miscellaneous expenses,	19 30	
		39,893 03
Horses, vehicles and stable account,		4,175 72
Total for North Metropolitan System,		$170,133 69
South Metropolitan System.		
Administration: —		
Commissioners,	$2,333 33	
Secretary and assistants,	2,086 17	
Rent,	214 50	
Amount carried forward,	$4,634 00	

General Character of Expenditures.	For the Year ending December 31, 1913.	
Amount brought forward,	$4,634 00	
South Metropolitan System — Con.		
Administration — *Con.*		
Heating, lighting and care of building,	190 64	
Postage,	21 00	
Printing, stationery and office supplies,	379 40	
Telephones,	46 64	
Traveling expenses,	9 00	
Miscellaneous expenses,	42 28	
		$5,322 96
General supervision: —		
Chief engineer and assistants,	$3,069 51	
Rent,	643 50	
Heating, lighting and care of building,	571 98	
Postage,	34 00	
Printing, stationery and office supplies,	133 19	
Telephones,	139 91	
Traveling expenses,	115 00	
		4,707 09
Ward Street pumping station: —		
Labor,	$22,388 55	
Fuel,	10,565 53	
Oil and waste,	249 40	
Water,	1,389 60	
Packing,	188 80	
Repairs and renewals,	1,770 12	
Telephones,	60 08	
General supplies,	1,003 05	
Miscellaneous supplies and expenses,	359 46	
		37,974 59
Quincy pumping station: —		
Labor,	$7,920 82	
Fuel,	1,610 32	
Oil and waste,	69 27	
Water,	223 20	
Packing,	41 59	
Repairs and renewals,	205 80	
Telephones,	34 73	
General supplies,	374 25	
Miscellaneous supplies and expenses,	68 51	
		10,548 49
Nut Island screen-house: —		
Labor,	$7,966 16	
Fuel,	1,702 40	
Oil and waste,	71 18	
Water,	315 66	
Packing,	15 86	
Repairs and renewals,	40 87	
Amounts carried forward,	$10,112 13	$58,553 13

General Character of Expenditures.	For the Year ending December 31, 1913.	
Amounts brought forward,	$10,112 13	$58,553 13
South Metropolitan System — Con.		
Nut Island screen-house — *Con.*		
Telephones,	41 28	
General supplies,	448 41	
Miscellaneous supplies and expenses,	10 00	
		10,611 82
Sewer lines, buildings and grounds: —		
Engineering assistants,	$3,651 92	
Labor,	16,890 28	
Automobiles,	331 01	
Brick, cement and lime,	246 00	
Castings, ironwork and metals,	170 29	
Freight, express and teaming,	1 31	
Fuel and lighting,	121 35	
Jobbing and repairing,	6 00	
Lumber,	300 97	
Machinery, tools and appliances,	219 74	
Paints and oils,	167 44	
Rubber and oiled goods,	192 22	
Sand, gravel and stone,	98 77	
Telephones,	33 00	
Traveling expenses,	229 75	
General supplies,	156 16	
Miscellaneous expenses,	75 72	
		22,891 93
City of Boston, for pumping and interest,		6,423 73
Horses, vehicles and stable account,		3,187 98
Total for South Metropolitan System,		$101,668 59

(b) *Receipts.*

The receipts from the sales of property, from rents and from other sources, have been credited as follows: —

Account.	For the Year ending December 31, 1913.
Construction: —	
North Metropolitan System,	$9,735 20[1]
South Metropolitan System,	76 75
Maintenance: —	
North Metropolitan System,	572 91
South Metropolitan System,	159 28
Metropolitan Sewerage Loans sinking fund,	65 79
	$10,609 93
Amount credited from beginning of work to January 1, 1913,	109,551 37
Total receipts to January 1, 1914,	$120,161 30

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[1] Includes the sum of $9,280.26, being amount received from Harvard College, in reimbursement for construction of the relocation of part of Section 30 in Cambridge.

(*c*) *Assets.*

The following is an abstract of the assets of the Sewerage Works, a complete schedule of which is kept on file in the office of the Board: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate connected therewith.

(*d*) *Liabilities.*

The sums due on monthly pay rolls amount to $784.32 and there are bills for current expenses which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

NAME.	Work.	Amount.
High-level Sewer: —		
National Contracting Co.,	Section 73, contract abandoned,	$5,516 17[1]
E. W. Everson & Co.,	Section 75, contract 14,	1,000 00
High-level Sewer Extension: —		
Timothy J. O'Connell,	Section 82, in part, contract 57,	60 00
North Metropolitan Construction: —		
William J. Barry,	Relocation part of Section 30, Cambridge, contract 102.	408 13
G. M. Bryne Co.,	Section 68, New Mystic sewer, contract 104,	5,183 30
Antony Cefalo,	Section 48A, contract 105,	246 62
Ross & Barbaro,	Section 70, New Mystic sewer, contract 103,	2,994 82

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[1] Damages claimed by the Commonwealth on account of the abandonment of the contract exceed this amount.

Claims have been made by the following parties for land taken and other damages, and suits are now pending in the courts for the determination of many of them: —

Anna L. Dunican, Carrie S. Urquhart, N. Jefferson Urquhart, Edwin N. Urquhart, Richard Jones, James Doherty, Michael Niland, William H. Gibbons, Francis Normile, Boston & Maine Railroad, Esther Cutting, Fred W. Joy *et al.*, David N. Skillings, John S. Lynam, Antonio Piluso.

VIII. RECOMMENDATIONS FOR LEGISLATION.

In the abstract of the annual report for the year 1913 the Board recommended that authority be given to construct a 24-inch pipe from the terminus of the 36-inch main at River Street in Dorchester through Milton and Quincy for a distance of about 13,000 feet, a reinforced concrete reservoir on Bellevue Hill in the city of Boston, a 20-inch force main leading to the reservoir, a power plant at the Sudbury Dam in Southborough and an extension of the sewerage outfall at Deer Island. The statement of the Board is as follows: —

"The southern high-service district is supplied with water pumped from Chestnut Hill Reservoir and stored in reservoirs on Fisher Hill in Brookline and Waban Hill in Newton. The district embraces the higher portions of the city of Boston, including Beacon Hill and the business portion of the city lying north of Washington Street between Boylston and Court streets, the portions of Roxbury, Dorchester and West Roxbury lying west of Dudley and Stoughton streets, the Hyde Park district of the city of Boston, the city of Quincy and the towns of Milton, Watertown and Belmont. The population supplied is approximately 332,000 and the daily average consumption for the past year was 29,870,000 gallons, with a weekly maximum of 33,650,000 gallons and a weekly minimum of 28,200,000 gallons. The available storage in the reservoirs named is 23,000,000 gallons, or 70 per cent. of the daily consumption during the weeks of maximum use. The city of Quincy and the town of Milton are located about ten miles from the pumping station and storage reservoirs and are supplied through a single line of pipes. The town of Milton has no local storage. In the city of Quincy there are two standpipes having a combined capacity of 755,000 gallons, and the Forbes Hill Reservoir, which may be used in case of emergency, with a capacity of 5,100,000 gallons.

"Since the city of Quincy was first supplied from the Metropolitan Water System the population of the city has increased from 23,000 to 35,500, and the daily average consumption from 1,370,000 to 2,700,000 gallons. The main supplying water to Quincy is also used to supply a considerable portion of the Dorchester, West Roxbury and Hyde Park districts of Boston and the town of Milton, and in both Dorchester and West Roxbury there has been a large increase in population during the past few years. As a result of the increased draft from the main, the pressure in Quincy is at times of greatest use reduced so low that the local standpipe has been several times emptied and the supply in the standpipe on Forbes Hill greatly reduced, and as there is but one main available for the supply of Quincy and Milton these municipalities are dependent in case of accident on the water stored in Forbes Hill Reservoir. In February, 1913, this main broke, and before it could be restored to service the quantity stored in the reservoir had been reduced to 1,500,000 gallons, sufficient to supply the city for but six to eight hours.

"The Board deems it desirable that another 24-inch pipe should be laid from the terminus of the 36-inch main at River Street in Dorchester through the town of Milton and the city of Quincy for a distance of 13,000 feet, to provide increased pressure and an additional means of supply. The cost of this 24-inch pipe and laying of the same is estimated at $72,000.

"The southern extra high-service water district embraces portions of the West Roxbury and Hyde Park districts of the city of Boston and the town of Milton which are above the elevation which can be adequately supplied with water from the high-service reservoirs on Fisher and Waban hills.

"Previous to January, 1913, water for the supply of the district was pumped at a small station in West Roxbury owned by the city of Boston and operated by the Board under an arrangement with the city, and raised to the standpipe on Bellevue Hill, which has a capacity when full of 135,000 gallons. The pumping station and the standpipe were built in 1885, and the station has been operated since 1899 by the Board. The portion of the town of Milton supplied by the southern extra high service was added in 1902 and Hyde Park in 1912.

"In January, 1913, the new station at Hyde Park was completed and its operation commenced and the station at West Roxbury was abandoned; but the small standpipe on Bellevue Hill is still the sole reliance for storing water for the use of the whole district in case of any accident to the pumping machinery. As the water stored in the standpipe, even when full, will supply the district for only a few hours, more storage is desirable both for domestic use and for protection in case of fire.

"The Board is of opinion that the construction of a reinforced concrete reservoir, having a capacity of 2,300,000 gallons, is necessary to meet the requirements of the district, the reservoir to be located on the summit of Bellevue Hill, on land set apart by the city of Boston for park purposes, covered by a reinforced concrete roof, surrounded by a wall of Quincy granite, forming a tower which can be made easily accessible to the public. The reservoir will provide storage sufficient to supply the whole district for more than two days, and will permit of a more economical operation of the pumping station.

"In connection with the construction of the reservoir it will be desirable to extend the existing 20-inch force main from the corner of Beach and Poplar streets to the reservoir, a distance of 5,600 feet. The cost of the reinforced concrete reservoir and tower is estimated at $75,000, and the extension of the 20-inch force main to the reservoir at $27,000, a total of $102,000.

"Preliminary estimates have been made of the amount which would be required for a plant for the production of electric power at the Sudbury Dam, located in the town of Southborough, and the various questions arising, as to the production of power and the means and opportunity for its disposal when manufactured, have been investigated. Whether electric power produced at this dam can be disposed of at prices sufficient to insure the Commonwealth against loss in the operation is in part dependent upon the valuation of the power plant for local taxation.

"The Board is of opinion that favorable arrangements can be made for the construction of the plant and its proper operation, and that an appropriation should be authorized which can be used for such construction if the power can be sold at a fair profit. Several possible purchasers are so situated that, if arrangements can be made with any of them, power would have to be transmitted but a short distance from the dam to reach the plant of the purchaser.

"Until an appropriation is made for the construction of the plant the Board will not be in a position to attempt to make any arrangements with would-be purchasers, and consequently the Board believes that an appropriation should be made this year, to be used only in case further examination of the proposed work shows that the plant can be operated at a profit to the Commonwealth.

"The amount estimated for the construction of the power plant at the dam is $80,000.

"The Legislature of 1912, by chapter 694 of the acts of that year, appropriated the sum of $600,000 for the purchase of certain property from the city of Boston. The property in question has been acquired by the Commonwealth, the amount paid therefor being $150,000, leaving a balance of $450,000 undisposed of.

"The Board recommends that authority be given to issue bonds, from time to time as may be required, for the above purposes to a total amount not exceeding $254,000, to be taken from said balance of $450,000, and that authority be given to expend said sum of $254,000 for the following purposes: —

For a 24-inch main from River Street in Dorchester, through Milton to Quincy,	$72,000
For a reinforced concrete reservoir on Bellevue Hill in Boston,	75,000
For a 20-inch force main to the reservoir on Bellevue Hill,	27,000
For a power plant at the Sudbury Dam,	80,000
	$254,000

"Complaints regarding the disposal of the sewage at the Deer Island outfall have been made, and in November of last year a letter was received from the Department of Commerce of the United States, stating that the present location 'near the Deer Island Lighthouse is a menace to the health of the keepers and a detriment to the maintenance of the station.' The department requested information regarding a possible extension of the outfall to a point where the running tide could 'carry off the effluvia and decrease the deposits on the base of the tower and the adjacent rocks.'

"In order to determine what could be done to remedy the alleged objectionable conditions, and render the discharge of the sewage unobjectionable in the future, the Board has had careful investigations made by competent engineers who have advised extending the present outfall sewer, by means of cast-iron pipe, directly out to the deep water of the channel, a distance of 333 feet. The Board approves of this method and believes that by carrying out the plan proposed there will be no disagreeable odor at the water surface at any stage of the tide.

"The amount estimated to extend the outfall as suggested and purchase material therefor is 125,000, divided as follows: —

260 tons of cast-iron pipe ranging from 5 to 7 feet in diameter, at $75 a ton,	$19,500
For laying pipe and furnishing all materials except the pipe, doing all necessary work of protecting the outfall, removing part of the existing outfall and making connections with the present sewer,	87,000
Add for engineering and contingencies,	18,500
	$125,000

"The Board recommends that authority be given to issue from time to time bonds denominated on the face thereof Metropolitan Sewerage Loan, to an amount not exceeding $125,000, to be expended for the extension of said outfall as outlined."

Towards the close of the year 1913 the chairman of the Board, Hon. Henry H. Sprague, was absent by reason of illness and consequently does not sign the above report. Early in January Mr. Sprague resigned and thus closed a connection with the work which has existed since the organization of the Metropolitan Water Board in June, 1895, at which time he was appointed chairman, a position which he held until the abolition of that Board in 1901. On March 20 of that year the Metropolitan Water and Sewerage Board was created and Mr. Sprague designated as chairman, which position he held until his resignation. His associates upon the Board cannot allow this period of devoted, unselfish and highly honorable service, both to himself and to the Commonwealth, to pass without making this simple record of their appreciation of its value.

The detailed reports of the Chief Engineer of the Water Works and of the Engineer of the Sewerage Works, with various tables and statistics, are herewith presented.

Respectfully submitted,

HENRY P. WALCOTT,
EDWARD A. McLAUGHLIN,
Metropolitan Water and Sewerage Board.

BOSTON, February 21, 1914.

REPORT OF CHIEF ENGINEER OF WATER WORKS.

To the Metropolitan Water and Sewerage Board.

Gentlemen: — The following is a report of the work done under the charge of the Chief Engineer of the Metropolitan Water Works for the year ending December 31, 1913.

General Statement.

The Chief Engineer has charge of the design and construction of all new works, and of the maintenance and operation of all the works controlled by the Metropolitan Water and Sewerage Board for supplying water to the eighteen municipalities which have received their supply from the Metropolitan Works.

Organization.

The Chief Engineer has had the following assistants: —

William E. Foss,	Assistant to Chief Engineer.
Elliot R. B. Allardice,	Superintendent of Wachusett Department.
Charles E. Haberstroh,	Superintendent of Sudbury Department.
Samuel E. Killam,	Superintendent of Pipe Lines and Reservoirs, Distribution Department.
Arthur E. O'Neil,	Superintendent of Pumping Stations, Distribution Department.
Alfred O. Doane,	Division Engineer, specially in charge of engineering work at pumping stations.
Clifford Foss,	Assistant Engineer.
Benjamin F. Hancox,	Assistant in charge of Drafting Department.
James W. Killam,	Assistant Engineer, in charge of tests of coal and oil.
William E. Whittaker,	Office Assistant.
Charles E. Livermore,	Biologist.
William W. Locke,	Sanitary Inspector.

At both the beginning and end of the year the engineering force, including those engaged upon both the construction and maintenance of the works, numbered 42. The average force was constituted as follows: —

Chief Engineer,	1
Department Superintendents,	4
Division Engineers,	2
Assistant Engineers,	7
Assistant Engineer and Sanitary Inspector,	1
Draftsmen,	2
Instrumentmen,	4
Rodmen,	2
Office Assistant,	1
Biologist,	1
Sanitary Inspectors,	2
Stenographers and Clerks,	10
Photographer and Blueprinter,	1
Messengers and Laboratory Assistants,	4
	42

There has been a maintenance force, exclusive of the engineers above mentioned, averaging 241, employed in the operation of the several pumping stations and in connection with the maintenance of the reservoirs, aqueducts and pipe lines, and in doing minor construction work.

The number of men employed in the maintenance force of the several departments has been as follows: —

	Beginning of Year.	End of year.	Average.
Wachusett Department,	46	40	51
Sudbury Department,	44	49	55
Distribution Department, pipe lines and reservoirs,	71	80	78
Distribution Department, pumping service,	54	56	57
	215	225	241

There has been a slight increase in the number of employees, due to the acquisition of Fisher Hill Reservoir and 14.41 miles of water mains in the town of Brookline, and also to an increase in the amount of forestry work done in the Sudbury Department.

CONSTRUCTION.

Extension of Works to Hyde Park.

Comparatively little work has been done in constructing new or additional works during the past year. The construction of the Hyde Park pumping station was nearly completed in 1912, and the station was placed in service on January 16, 1913, but many of the bills were not paid until 1913.

The work done has included the laying of a tile floor in the engine room and concrete floor in the basement of the station, the adjusting, painting and testing of the engines, grading and surfacing lawns, driveways and walks, including the setting of edgestones, laying granolithic walks and planting shrubbery; the installation of an engine and generator for use in lighting the building, the furnishing and placing of cast-iron plates forming the floor between the high and low pressure portions of each of the engines, and the installation of mercury and electric gages for indicating and recording the elevation of the water at different points.

The engines were guaranteed by the Laidlow-Dunn-Gordon Company to give a duty of 115,000,000 foot pounds per 1,000 pounds of steam when operated at the rate of 3,000,000 gallons in 24 hours, and 105,000,000 foot pounds when operated at the rate of 1,500,000 gallons in 24 hours, and the builder was entitled to a bonus of $100 for each million foot pounds of work done in excess of the guarantee. The results of the tests were as follows: —

Date of Test.	Number of Engine.	Rate (Gallons).	Duration (Hours).	Duty (Foot Pounds).	Bonus.
September 16, ...	13	1,500,000	12	105,852,000	$85 20
September 18, ...	13	3,000,000	12	119,795,000	479 50
October 9, ...	14	1,500,000	12	106,633,000	163 30
October 10, ...	14	3,000,000	12	121,022,000	602 20
					$1,330 20

In connection with the grading of the grounds, 2,162 cubic yards of loam were furnished by T. H. Corrigan, of Hyde Park, for $1.30 per cubic yard; 235 tons of crushed stone were furnished for the driveways by the West Roxbury Trap Rock Company for $1.25 per ton; 2,339 square feet of granolithic walk were built by Warren

Brothers for $0.203 per square foot; and 411 feet of curb stone were set by the city of Boston at a cost of $0.722 per foot. The driveways were built, shrubs planted and lawns seeded by the department force. The tile floor of the engine room was laid by the Galassi Mosaic & Tile Company for $220, or about 10 cents per square foot, the tiles being purchased by the Commonwealth at a cost of about 22 cents per square foot.

During the month of April 152.5 feet of 24-inch pipe were laid at the junction of Hyde Park Avenue and Walkhill Street over the new channel of Stony Brook, replacing the temporary pipe line laid on private property during the previous year. Eleven flexible ball and socket joints were placed in the permanent line to provide against leaks due to settlement of the street. This work cost $1,068.62.

The total amount expended on account of the extension of works to Hyde Park, including the cost of the pumping station, has been as follows: —

	During the Year 1913.	Total January 1, 1914.	
Pipe Lines: —			
Section 39,	$1,553 49	$54,079 88	
Section 40,	571 73	31,270 85	
Section 41,	818 06	17,606 29	
			$102,957 02
Pumping Station: —			
Land,	–	$7,032 78	
Grading, fencing, edgestones, driveways, walks and shrubbery,	$5,321 64	9,337 70	
Side track,	–	2,449 43	
Building, including concrete foundation, coal pocket and chimney,	6,610 94	35,243 96	
Boilers,	369 54	3,667 06	
Engines,	12,484 03	19,457 19[1]	
Piping, heating, etc.,	1,597 77	3,343 70	
Suction and force main connections,	631 25	1,310 11	
Engineering and preliminary,	2,380 10	13,250 61	
			95,092 54
Total for Hyde Park extension,	. .	. .	$198,049 56
Amount appropriated for the work,	. .	. .	$212,000 00

[1] Including $1,725.50 unpaid.

PURCHASE OF WORKS OF THE CITY OF BOSTON IN THE TOWN OF BROOKLINE AND CITY OF SOMERVILLE.

The acquisition by the Board of Fisher Hill Reservoir and the large mains previously owned and used by the city of Boston for the purpose of conveying water through the town of Brookline and the city of Somerville into its own limits, was authorized by chapter 694 of the Acts of the year 1912, and the sum of $600,000 was appropriated for the purpose. A taking of the property was made on

August 20, 1913, and the sum of $150,000 has been paid in full settlement therefor.

The property taken includes Fisher Hill Reservoir, with a capacity of 15,400,000 gallons, and the fee of 459,670 square feet of land connected therewith, also 14.41 miles of main pipes in sizes from 20 to 48 inches in diameter. The taking of the pipe lines includes the fee in 133,758 square feet of land, and easements in 120,138 square feet, both included in the location of a 48-inch pipe line extending from Beacon Street in Brighton to Boylston Street in Brookline. Of this land 53,558 square feet held in fee, and 67,738 square feet held in easements, are now utilized for public and private streets and by the Boston & Albany Railroad Company. The taking also included that portion of the Cochituate Aqueduct between Chestnut Hill pumping station No. 1 and Webber's waste-weir, a distance of 750 feet. The length and size of the several pipe lines taken are as follows: —

	12-inch.	20-inch.	24-inch.	30-inch.	36-inch.	40-inch.	42-inch.	48-inch.
Southern High-service Mains: —								
Connection at Fisher Hill Reservoir, Brookline, laid 1886,	-	-	-	20	156	-	-	-
Park land, Chestnut Hill Avenue, Buckminster Road and Fisher Avenue, Brookline and Brighton, 30-inch pipe laid 1886, 36-inch, 1894,	-	-	-	4,729	4,455	-	-	-
Fisher Avenue park land, Lee, Warren, Dudley, Cottage and Perkins streets, Brookline and West Roxbury, 30-inch pipe laid 1886, 42-inch, 1897,	-	-	-	6,818	153	-	1,108	-
Boylston, Warren, Walnut and Washington streets, Brookline, laid 1895,	-	-	-	-	20	-	-	7,965
Low-service Mains: —								
Park land, Brighton, laid 1877,	-	-	-	-	-	-	-	475
Beacon Street, Clinton Path, private land, Clinton Road, private land, Buckminster Road, Brookline and Brighton, laid 1869,	-	-	-	74	79	84	-	6,930
Boylston and Washington streets, Brookline Avenue, Brookline, 30-inch and 36-inch pipes laid 1848, 40-inch, 1859,	-	-	-	5,580	5,580	6,905	-	-
Beacon Street, Brookline and Brighton, laid 1880,	-	-	-	-	-	-	-	13,120
Centre, Fuller and Harvard streets, Brookline, laid 1894,	-	3,514	-	-	-	-	-	-
Broadway, Somerville, laid 1864,	-	-	3,913	-	-	-	-	-
Pearl, Mt. Vernon and Perkins streets, Somerville, cement-lined pipe laid 1870,	19	-	-	4,385	-	-	-	-
Totals,	19	3,514	3,913	21,606	10,443	6,989	1,108	28,490

76,082 linear feet, 14.41 miles.

Connected with these mains, for the purpose of controlling the flow of water, there are 1 12-inch, 1 20-inch, 1 24-inch, 12 30-inch, 9 36-inch, 2 40-inch and 1 48-inch valves, and 34 air valves. There are also connected with these mains, for use in draining same, 60 feet of 6-inch pipe and 2 6-inch valves, 5 feet of 8-inch pipe and 1 8-inch valve, 1,010 feet of 12-inch pipe and 15 12-inch valves, and 445 feet of 16-inch pipe and 7 16-inch valves.

WATER PIPE TUNNEL UNDER CHELSEA CREEK.

The Legislature on June 6, 1913, authorized the expenditure of $75,000 for the purpose of lowering the water mains which now cross Chelsea Creek between Chelsea and East Boston. This is to be done in order that the pipes shall not interfere with the dredging of the channel to a depth of 25 feet below mean low water. Plans have been prepared for the construction of a tunnel 520 feet long between the vertical shafts, through which a 42-inch cast-iron water pipe is to be carried across the creek channel at a depth sufficient to permit the dredging of a channel in the future 35 feet deep at mean low water. The plans have received the approval of the Directors of the Port, and work is to be commenced as soon as the approval of the Secretary of War is received. Twelve borings have been made to determine the character of the material through which the tunnel is to be constructed. The amount expended on account of this work to January 1, 1914, was $1,970.51.

IMPROVEMENT OF BEAVER DAM BROOK.

Chapter 814 of the Acts of the year 1913, approved June 16, authorized the Metropolitan Water and Sewerage Board to expend $33,000 in widening, straightening and deepening Beaver Dam Brook, a tributary of Lake Cochituate, which has its source at Waushakum Pond, in Ashland, and flows in an easterly and northerly direction for a distance of 21,300 feet into the south end of Lake Cochituate.

The contemplated improvement includes the construction of a channel with a plank bottom 1½ feet in width, with side slopes of 4 horizontal to 1 vertical, the slopes to be paved with stone for a distance of 1½ feet from the bottom of the slopes on the straight portions of the brook and somewhat higher on the curves; the depth of the present channel to be slightly increased, the alignment straightened and the bottom given a uniform grade of 1 in 1,400. Construction is not to begin until easements, giving rights to construct and maintain the channel, have been obtained from the property owners along the line of the brook. One third of the expense incurred is to be paid by the town of Framingham.

MAINTENANCE.

Rainfall and Yield.

The rainfall on the Wachusett watershed during the year 1913 was 41.22 inches and on the Sudbury watershed 44.31 inches. On both watersheds the rainfall was below the average of past years, but more than during the previous three years on the Wachusett watershed and the previous five years on the Sudbury watershed. Notwithstanding the larger rainfall, the yield, or quantity collected, on these watersheds was slightly less than in 1912, being 879,000 gallons per square mile per day on the Wachusett watershed and 733,000 gallons per square mile per day on the Sudbury watershed.

Storage Reservoirs.

The following table shows the total capacity of the several storage reservoirs and the quantity stored in each at the beginning and end of the year: —

Storage Reservoirs.	Capacity (Gallons).	Amount stored.	
		January 1, 1913 (Gallons).	January 1, 1914 (Gallons).
Cochituate watershed: —			
Lake Cochituate, including Dudley Pond,	2,328,300,000	1,732,100,000	2,043,900,000
Sudbury watershed: —			
Sudbury Reservoir,	7,253,500,000	5,848,700,000	6,731,400,000
Framingham Reservoir No. 1,	287,500,000	226,000,000	220,400,000
Framingham Reservoir No. 2,	529,900,000	491,200,000	538,900,000
Framingham Reservoir No. 3,	1,180,000,000	1,055,100,000	900,500,000
Ashland Reservoir,	1,416,400,000	1,379,500,000	1,412,000,000
Hopkinton Reservoir,	1,520,900,000	1,481,400,000	1,508,900,000
Whitehall Reservoir,	1,256,900,000	1,227,500,000	1,196,300,000
Farm Pond,	167,500,000	126,400,000	125,400,000
Wachusett watershed: —			
Wachusett Reservoir,	64,968,000,000	50,652,200,000	55,146,300,000
Totals,	80,908,900,000	64,220,100,000	69,824,000,000

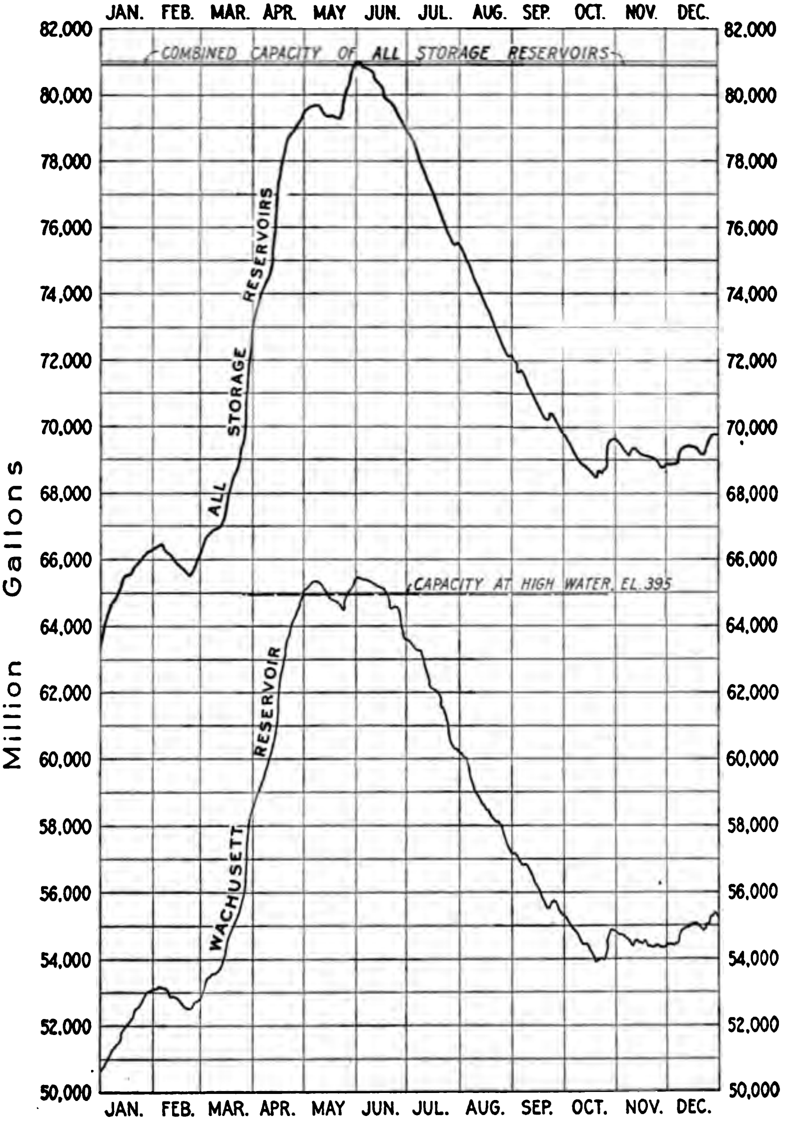
The diagram on the opposite page shows the quantity of water stored at different times throughout the past year in all the reservoirs combined and in the Wachusett Reservoir alone. The several reservoirs were practically full early in June, and there was a net gain in the quantity stored during the year of 5,603,900,000 gallons.

Wachusett Reservoir. — At the beginning of the year the surface of the water in this reservoir was 11.21 feet below high-water mark, and this was the lowest point during the year. The reservoir surface rose 2.07 feet during January, followed by a fall of 0.51 of a foot to February 22. From this date the rise was continuous, and on April 29 high-water mark (elevation 395) was reached. Stop-planks were placed on the wasteway and the reservoir allowed to rise above high water, where it remained the greater portion of the time until June 18. The maximum elevation was 395.38 on May 31. During the period while the reservoir was above high-water mark, no water was intentionally wasted, but there was a leakage of 71,700,000 gallons through the joints between the flash-boards on the waste-weir. From June 2 to October 19 there was a continuous fall of the reservoir, due to a draft for supplying the District, amounting in the aggregate to 8.92 feet. After October 19 the reservoir surface rose very slowly, and at the end of the year was 7.52 feet below high water and 3.69 feet higher than at the beginning of the year. In compliance with the requirements of chapter 488 of the Acts of the year 1895, 826,400,000 gallons of water were discharged into the Nashua River below the dam, at the rate of not less than 12,000,000 gallons per week, for the use of the Lancaster Mills.

It has been necessary to continue the removal of soil from varying widths of land bordering on the shore of the reservoir between Hastings Cove, in Boylston, and Pine Hill in West Boylston, on the south shore, and at Kendall Cove, in Boylston, on the north shore, for an aggregate distance of 9,380 feet. In connection with the work of soil stripping, tree stumps, roots, logs and miscellaneous débris found along the shore entirely around the reservoir were collected and burned at a total cost, including the stripping of the soil, of $1,788.46.

The improvement of a shallow flowage area on the east side of Thomas Basin, opposite the Oakdale Station of the Boston & Maine Railroad, which was begun in 1912 and mentioned in the last annual report, was completed early in the year. Including the work done

DIAGRAM SHOWING
QUANTITY OF WATER STORED IN THE WACHUSETT RESERVOIR AND IN ALL THE STORAGE RESERVOIRS COMBINED DURING 1913



in 1912, 2,350 cubic yards of loamy material were removed from the bottom of the reservoir and deposited along the shore in the form of an embankment having an area of about 0.6 of an acre. This embankment was faced on the side exposed to the water with boulders and cobbles from the excavation. On the surface of the fill and the adjacent shore of the reservoir 1,830 white pine and 375 arbor vitæ trees have been planted. The cost of this improvement, including the work done in 1912, was $1,305.58.

The work of repairing the concrete crest of the dam over which the flow of the Quinepoxet River is discharged into the reservoir was referred to in the report for 1912. The work has been continued during the past year, and all of the crest which showed any material signs of disintegration has been repaired by cutting out the disintegrated concrete to a depth of from 2 to 3 inches and replacing it with Portland cement mortar secured to the sound concrete by means of iron bolts and wire netting. The amount expended for the work was $312.21.

An area of about 2 acres, forming a part of the easterly portion of the North Dike, where considerable settlement of the material had taken place since the dike was built, and an area of 3½ acres on the westerly portion of the dike, where fire had destroyed the timber growth, have been graded, covered with loam, fertilized with 338 cubic yards of sludge hauled from the Clinton sewerage filter-beds and seeded at a cost of $1,287.41.

For the purpose of keeping cattle off the property of the Commonwealth, a 4-strand plain wire fence has been erected for a length of 919 feet between land of the Board and Demetrius John, in West Boylston, and an equivalent length of fence has been erected by Mr. John.

Standing and rowen grass from 422 acres of the marginal lands of the reservoir and the North and South dikes was sold at public auction for $3,436.50. This amount is somewhat less than that received the previous year, but is in excess of the average.

The west shore of the Stillwater Basin, alongside the tracks of the Boston & Maine Railroad, has, for a distance of 100 feet, been protected from erosion with light riprap.

Eight life preservers have been placed at the most dangerous points about the reservoir and dam for use in cases of accident.

Brush and weeds have been mowed, raked and burned from all highways fronting the property of the Board, from the face and riprap berm of the North and South dikes, and from the margin along the flow line of the reservoir. This work extended over 56.5 miles and cost about $2,500.

In the vicinity of the Wachusett Reservoir the Board owns 14 houses, 10 of which are occupied by its employees engaged upon the care of the works. During the past year $2,304.34 was expended upon repairs to these houses, of which $1,386.93 was paid for repairs to the Cook house and barn, on the Oakdale-Clinton Road, in fitting it for the use of one of the foremen. The amount received for rent of these houses was $1,244.84.

Wachusett Dam and Grounds. — The dam, together with the adjacent structures and grounds, is in good condition. Measures taken in 1912 to prevent leakage through the roof of the upper gate-chamber, described in the last annual report, proved efficacious until recently, when a slight leakage took place, which was stopped by applying another coat of Minwax.

Asphaltum which was originally placed in the joints between the granolithic blocks on the top of the dam has been removed, except over the gate and bastion chambers, and replaced with Luxfer Prism compound. All iron fences on the dam, the ironwork in the upper gate-chamber, and the iron flash-board standards on the waste-weir have been painted. The interior walls and ceiling of the upper gate-chamber were given two coats of Toch Brothers' "Konkerit," for the purpose of preventing further discoloration from alkali exuding from the brickwork and concrete. This treatment has not proved satisfactory and further experiments are in progress.

A small masonry weir has been built under the railroad bridge below the dam, by means of which measurements can be taken of the water leaking through the flash-boards at the waste-weir. Two hundred and thirty cubic yards of sludge from the Clinton sewerage settling basins have been used as a fertilizer on the lawns about the dam. A bubbler has been attached to the drinking trough, in order to avoid the use of a public drinking cup.

Sudbury Reservoir. — The surface of the water in this reservoir was 2.46 feet below the crest of the overflow on January 1, 1913, and remained between 2.5 and 3.5 feet below the crest until March 20. For the greater portion of the time during the remainder of the year the water was kept above the crest by the use of stop-planks, but on December 31 was 0.20 of a foot below the crest and 2.26 feet higher than at the beginning of the year. Minor repairs have been made on two houses owned by the Board and occupied by its employees, one on Farm Street near the Marlborough filter-beds, and one at Fayville. The outer portion of the roof of the barn near the Sudbury Dam has been reshingled and the barn and attendant's house painted. A Wheelock No. 65 wire fence, 659 feet long, was built on a portion of the property line between the Commonwealth and Ida M. Kaler, and a fence of the same pattern, 552 feet long, on the line between land of the Commonwealth and J. F. Chickering. A dressing of loam and chemical fertilizer was placed on the top and outer slope of the dam.

Framingham Reservoir No. 1. — No water was drawn from this reservoir for the supply of the Metropolitan District, and water was wasted at the outlet dam nearly all of the time throughout the year.

Framingham Reservoir No. 2. — No water was drawn from this reservoir during the year for the supply of the Metropolitan District, and it remained full, except from August 20 to December 6, during which time it was kept about 3 feet below high water, in order to facilitate the widening of the Boston & Albany Railroad bridge which crosses the southerly end of the reservoir. The railroad bridge and roadbed have been widened so as to permit the laying of two additional tracks and to provide for a ditch between the outer track and the reservoir, in which wash from the roadbed can be diverted from the reservoir. The slope of the railroad embankment has been protected by riprap. The brush growing along the shore at the upper end of the reservoir was cut and the shores cleaned, and the grassed slopes of the embankment at the dam given a dressing of loam and chemical fertilizer.

Framingham Reservoir No. 3. — The greater portion of the water used in the Metropolitan District has been drawn from this reservoir, and it has been kept nearly full throughout the greater part of the year with water from the Wachusett Reservoir. During October, November and December the reservoir surface was kept about 2 feet below the stone crest of the dam, in order to facilitate the cleaning of the shores. No water was wasted from the reservoir during the year. The land held around this reservoir for the protection of the water supply has been increased in area by the purchase of 3.48

acres of land from Myra F. Hessel for $2,500; 3.43 acres from A. O. Stensson for $450; and 2.41 acres from C. A. Nelson for $250. These parcels have been acquired at points where the width of the marginal land controlled by the Commonwealth was very narrow.

Ashland, Hopkinton and Whitehall Reservoirs. — No water was drawn from any of these reservoirs for use in the Metropolitan District, and they all remained substantially full throughout the entire year. At the Ashland and Hopkinton reservoirs débris has been removed from along the shores, and loam and chemical fertilizer spread on the grassed slopes of the dams. A No. 65 Wheelock wire fence, 790 feet long, was built on the property line between the Commonwealth and H. M. and W. M. MacNear, below the Ashland Dam, in order to prevent cattle from obtaining access to the water in the channel below the reservoir. One cottage has been built near the shore of Whitehall Reservoir, and there are now 61 cottages near the shore, used by summer residents, also 129 boats of different kinds in use on the reservoir.

Farm Pond. — The town of Framingham has drawn 276,300,000 gallons from a filter-gallery alongside the shores of this pond, and 85,400,000 gallons of water have been delivered into the pond from Framingham Reservoirs Nos. 1 and 2 through the Sudbury Aqueduct.

Lake Cochituate. — The lake was 2.31 feet below high-water mark at the beginning of the year. It was substantially full and water was wasted at the dam at times from January 11 until June 23. A draft of 15,000,000 gallons per day for the supply of the District was maintained from August 11 until the end of September, lowering the water to elevation 141.82. After October 1 it rose slowly and at the end of the year stood at elevation 143.51, or 0.85 of a foot below high-water mark. The house occupied by the foreman has been painted and portions of the roof reshingled. A concrete basin has been built at the point where Bannister's Brook discharges into the channel which receives the surface drainage from the village of Cochituate, for the purpose of catching sand and other material brought down by the brook. The sand catcher consists of two basins, each 4 feet 3 inches wide x 33 feet 6 inches long, with side-walls of concrete, resting on a platform of 3-inch tongued and grooved plank, and is so arranged that the basins can be alternately drained and cleaned. The cost of the sand catcher and paved entrances to the diversion channel was $957.47. Three 15-inch Akron pipe drains, each 50 feet long, were laid for the purpose of draining the adjoining land into the diversion channel, at a cost of $277.81.

Miscellaneous Work on the Sudbury Watershed. — Considerable work has been done in connection with the determination and marking of the lines of property belonging to the Board in Cedar Swamp. Thirty-six bounds made of reinforced Portland cement, and 27 2-inch iron pipes from 7 to 20 feet long, have been placed to define the property lines at Cedar Swamp. Fourteen bounds have been set at Framingham Reservoir No. 3, 18 at Lake Cochituate, 10 at the Sudbury Reservoir and 37 at Whitehall Reservoir. The trees and brush have been cut and removed along the lines of property belonging to the Board in Cedar Swamp for a width of 5 feet and a distance of 13,145 feet, and at Whitehall Reservoir for a distance of 16,782 feet.

Fifteen life preservers have been placed at different points about the reservoirs where it is thought they may be of service in case of accidents.

SOURCES FROM WHICH WATER FOR THE SUPPLY OF THE METROPOLITAN DISTRICT HAS BEEN TAKEN.

An average of 84,830,000 gallons of water per day was drawn from the Wachusett Reservoir through the Wachusett Aqueduct into the Sudbury Reservoir. The following quantities of water have been drawn for use in the Metropolitan District: —

	Daily Average Gallons.
From the Sudbury Reservoir through the Weston Aqueduct, . .	35,943,000
From Framingham Reservoir No. 3 through the Sudbury Aqueduct,	64,624,000
From Lake Cochituate through the Cochituate Aqueduct, . .	2,425,000
	102,992,000

The drainage area of Spot Pond furnished a daily average of 317,000 gallons.

AQUEDUCTS.

The *Wachusett Aqueduct* was in use during the whole or portions of 288 days, but as the flow of water through the aqueduct is largely governed by the operation of the turbines at the power station, the actual time used was but 150 days, 18 hours and 52 minutes. The total quantity of water drawn from the Wachusett Reservoir into the aqueduct was 31,023,900,000 gallons, of which 28,527,600,000 gallons, or 92 per cent., was used before its admission into the aqueduct for developing electric energy. The Westborough State Hospital has drawn from the aqueduct 60,904,000 gallons, equivalent to a daily average of 167,000 gallons. The work done in connection with the maintenance of the aqueduct has included the removal of sods and bunch grass along the high-water mark of the open channel, for a distance of 4,785 feet, at a cost of $189.46; the construction of 302 feet of fence adjacent to land of Michael Wyzenski in Northborough; 472 feet alongside the Northborough Road in Southborough; and 668 feet between land of the Board and pasture land of F. H. Ballou in Southborough. Wheelock wire fence was used in all cases. The ironwork in the terminal chamber, the iron pipe rail fences on the Assabet bridge and at the crossing of Bartlett Street, in Northborough, and fences and other ironwork at six highway bridges and two dams along the open channel have been painted with Smith's durable metal coating. Six acres of land in Marlborough, lying on the southerly side of the open channel, about one quarter of a mile below the terminal chamber, have been cleared. This area was covered with oak, chestnut, birch and apple trees which were badly infested with gypsy and brown-tail moths and the chestnut bark disease. The wooden covers over two supply wells, from which water is supplied to a few takers in West Berlin, have been replaced with more permanent covers composed of 4-inch reinforced concrete slabs, supported by I beams, at a cost of $223.65.

The *Sudbury Aqueduct* was in use during portions of 364 days and carried to Chestnut Hill Reservoir a daily average of 64,624,000 gallons, which was 9,597,000 gallons per day less than during the previous year. On August 13 and 14 the aqueduct was used to convey 85,400,000 gallons of water from Framingham Reservoirs Nos. 1 and 2 to Farm Pond. Fences have been built, rebuilt or repaired along the line of this aqueduct as follows: 180 feet of wooden fence with two 2-inch x 6-inch rails on both sides of Leach's Lane at South Natick; 158 feet of fence of the same pattern on both sides of Cartwright's Lane at Wellesley; 32 feet on the northwesterly side of Kendall Street at Sherborn; 799 feet on both sides of Brook Street at South Natick; 312 feet on both sides of Great Plains Avenue at Wellesley; 90 feet on the easterly side of Forest Street at Wellesley; 275 feet on the west side of the westerly crossing of Wellesley Avenue; 444 feet on both sides of Brookside Road at Wellesley; 200 feet on both sides of Oakland Street at Wellesley; and 252 feet on both sides of the easterly crossing of Wellesley Avenue, a total of 2,742 feet. No. 65 Wheelock wire fence has been built for a distance of 336 feet on the property line on the south side of the aqueduct, easterly from Great Plains Avenue in Wellesley, and 3,026 feet on property lines at Hurd's embankment. Board rail fences have been repaired for a distance of 583 feet. A concrete floor has been placed in the middle compartment of the storehouse near the west siphon chamber. Twenty-five thousand, three hundred pounds of chemical fertilizer have been spread on the surface of the embankments for an aggregate length of 28,400 feet of the aqueduct, at a cost of $414. The iron beams and rafters which support the slate roof at the gatehouse at Farm Pond and at the west siphon chamber, the iron fence on the Waban bridge, the doors of the siphon and waste-weir chambers, and the manhole covers along the line have been cleaned and given one coat of paint, and the wooden steps at the east and west siphon chambers and Echo bridge have been oiled.

The *Cochituate Aqueduct* was in use on 62 days during the year. Minor repairs have been made to the aqueduct and connected structures, as follows: a new floor, composed of steel grating supported by 5-inch I beams has been placed in the pipe chamber on the east side of the Charles River, in place of the old floor which was in poor condition, and which was also so low that it was under water when large quantities of water were run through the aqueduct. The driveway leading to this chamber has been graded so that the building can be reached by teams. The doors of the pipe and waste-weir chambers and the manhole covers have been painted. The interior of the aqueduct was inspected but not cleaned, as it was not considered necessary. Seven single cartloads of stone which had fallen or become loosened from the roof of the Newton tunnel during the construction of the supply pipe line tunnel near by were removed.

The *Weston Aqueduct* was in use for conveying water from the Sudbury Reservoir to the Metropolitan District throughout the year except for four hours on January 13 and between March 18 and April 10, while the section of the aqueduct, 5,660 feet long, between the Weston Reservoir and the terminal chamber was being cleaned and repaired. The total quantity of water delivered through the aqueduct for the year was 13,119,200,000 gallons, equivalent to a daily average of 35,943,000 gallons. The cleaning of the aqueduct was done in the following manner: two gangs of men were employed one beginning at each end of the section to be cleaned and working toward each other. One gang used water and hand brooms in cleaning the sides and top of the aqueduct, a wagon with a tank body being used when cleaning the top. The second gang made use of the gasolene power sprayer by which water under 200 pounds' pressure was discharged against the interior surface of the aqueduct. This method proved more efficient, more economical and quicker than the hand method. The cleaning of the bottom was done with push brooms operated by hand. The ironwork of the gates and stop-plank grooves in the screen and terminal chambers was thoroughly scraped, dried by the use of torches, and painted with two coats of red lead and oil. When the aqueduct was first emptied it was found that water was flowing in through small crevices in the brick and concrete, the greater number of which were between stations 659 and 671, where the aqueduct is generally in tunnel. In this section 1,400 leaks in the tunnel lining were repaired by driving and calking wedge lead, tea lead or lead wool into the joints. The cost of cleaning and repairing this section of the aqueduct was as follows: —

	Labor.	Materials.	Total.
Cleaning aqueduct,	$270 05	$4 58	$274 63
Cleaning and painting ironwork,	121 00	21 27	142 27
Repairing leaks in masonry,	96 75	37 10	133 85
	$487 80	$62 95	$550 75

The exterior of the 90-inch steel pipe, through which the water is carried over the Sudbury River, and the ironwork in siphon chamber No. 1 have been painted. Witch grass roots have been planted on an area of about 10,000 square feet on the south slope of the aqueduct embankment near siphon chamber No. 2.

Sixteen thousand, eight hundred pounds of chemical fertilizer were spread on the aqueduct embankment for a distance of 21,000 feet, at a cost of $289.

Sewers along Sudbury and Cochituate Aqueduct Lines.

No new sewers have been constructed during the year to receive the drainage from houses in close proximity to the aqueducts, but two houses in Newton were connected with sewers built in 1912.

A payment of $4,990.61 has been made to the city of Newton during the year on account of sewers built in Grant Avenue and Hammond Street in 1912.

PUMPING STATIONS.

Sixty-seven per cent. of the water supplied to the Metropolitan District has been pumped at the two stations at Chestnut Hill Reservoir, and the remainder has been delivered by gravity. The total quantity pumped at the five stations was 28,672,920,000 gallons, which was 12.7 per cent. less than in 1912. The cost of operating the stations was $98,166.39, equivalent to $3.424 per million gallons pumped. The total cost was less than for the previous year, but the cost per million gallons shows an increase of $0.226, due to a reduction in the amount pumped.

Coal for use at the several stations has been delivered into the bins, as follows: —

BY WHOM FURNISHED.	GROSS TONS.					Cost per Gross Ton, in Bins.[1]
	Chestnut Hill Pumping Station No. 1.	Chestnut Hill Pumping Station No. 2.	Spot Pond Station.	Arlington Station.	Hyde Park Station.	
Gorman-Leonard Coal Company, bituminous,	110.76	-	-	-	-	$4.28
Gorman-Leonard Coal Company, bituminous,	1,510.71	-	-	-	-	4.00
Gorman-Leonard Coal Company, bituminous,	-	1,945.89	-	-	-	3.95
Gorman-Leonard Coal Company, bituminous,	-	2,314.41	-	-	-	3.87
C. W. Claflin & Co., buckwheat anthracite,	113.21	-	-	-	-	3.09
C. W. Claflin & Co., buckwheat anthracite,	79.29	-	-	-	-	3.04
C. W. Claflin & Co., buckwheat anthracite,	-	275.00	-	-	-	2.91
C. W. Claflin & Co., buckwheat anthracite,	-	504.06	-	-	-	2.89
Locke Coal Company, bituminous,	-	-	428.26	-	-	5.15
Locke Coal Company, bituminous,	-	-	301.68	-	-	4.78
Locke Coal Company, screenings,	-	-	417.37	-	-	2.50
Bader Coal Company, bituminous,	-	-	-	274.13	-	4.51
Bader Coal Company, bituminous,	-	-	-	156.41	-	4.40
Roxbury Coal Company, bituminous,	-	-	-	-	8.89	5.32
Spring Coal Company, bituminous,	-	-	-	-	86.70	4.61
Gorman-Leonard Coal Company, bituminous,	-	-	-	-	141.74	4.11
E. B. Townsend Coal Company, bituminous,	-	-	-	-	47.50	4.11
J. A. Whittemore's Sons, screenings,	-	-	-	-	48.43	2.52
Roxbury Coal Company, pea,[2]	-	-	-	-	24.15[2]	5.88[2]
Total gross tons, bituminous,	1,621.47	4,260.30	729.94	430.54	284.83	-
Total gross tons, anthracite,	192.50[3]	779.06[3]	-	-	-	-
Total gross tons, anthracite screenings,	-	-	417.37	-	48.43	-
Average price per gross ton, bituminous,	4.02	3.91	4.99	4.47	4.30	-
Average price per gross ton, anthracite,	3.07[3]	2.90[3]	-	-	-	-
Average price per gross ton, anthracite screenings,	-	-	2.50	-	2.52	-

[1] Includes cost of unloading coal from cars and all expenses incidental to storage of the coal.

[2] West Roxbury station.

[3] Buckwheat.

Bituminous coal has been purchased under contracts which provide for a deduction from the contract price in case the coal contains less than 14,700 British thermal units or more than 8 per cent. of ash, and for a bonus for coal containing more than 14,800 British thermal units. The following table shows the results of the tests made of the several kinds of coal received: —

KIND OF COAL.	Number of Samples tested.	British Thermal Units.	Percentage of Volatile Matter.	Percentage of Ash.	Percentage of Moisture.
Beaver Run,	61	14,554	17.40	8.04	2.76
Sterling,	17	14,772	21.89	6.84	2.83
Sonman,	10	14,710	17.91	6.84	3.33
Georges Creek,	9	14,537	18.19	7.94	2.37
New River,	8	14,844	17.23	5.80	2.90
Vulcan,	2	14,917	21.39	5.62	3.17
Carbon Forge,	1	14,841	17.92	6.21	2.18
Condor,	1	14,970	17.67	5.32	2.72

Chestnut Hill Pumping Stations.

At these stations a daily average of 32,299,000 gallons of water was raised 121.71 feet for the supply of the southern high-service district, and a daily average of 37,651,000 gallons was raised 39.07 feet for the supply of the low-service districts and for the northern high-service district. Statistics relative to the operation of the several engines at these stations are as follows: —

	PUMPING STATION No. 1.			PUMPING STATION No. 2.	Totals.
	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Engine No. 12.	
Daily pumping capacity (gallons),	[1]16,000,000	20,000,000	30,000,000	40,000,000	106,000,000
Total quantity pumped (million gallons),	459.35	23.56	3,991.82	7,314.38	11,789.11
Daily average quantity pumped (gallons),	1,258,000	65,000	10,937,000	20,039,000	32,299,000
Coal used in pumping (pounds),	1,212,759	29,525	2,783,226	4,921,045	8,946,555
Gallons pumped per pound of coal,	378.76	797.97	1,434.24	1,486.35	1,317.73
Average lift (feet),	133.99	120.15	119.19	122.32	121.71
Cost of pumping: —					
Labor,	$2,054 90	$83 63	$9,808 56	$7,622 69	$19,569 78
Fuel,	2,189 62	52 98	5,012 72	8,364 56	15,619 88
Repairs,	338 72	13 79	1,902 24	1,114 10	3,368 85
Oil, waste and packing,	44 10	1 80	210 50	357 69	614 09
Small supplies,	42 30	1 72	201 91	176 18	422 11
Totals,	$4,669 64	$153 92	$17,135 93	$17,635 22	$39,594 71
Cost per million gallons pumped,	$10.1658	$6.5331	$4.2928	$2.4110	$3.3586
Cost per million gallons raised 1 foot high,	.0759	.0544	.0360	.0197	.0276

[1] 8,000,000 each.

	Chestnut Hill Pumping Station No. 2. — Engines Nos. 5, 6 and 7.
Daily pumping capacity each engine (gallons),	35,000,000
Total quantity pumped (gallons),	13,742,460,000
Daily average quantity pumped (gallons),	37,651,000
Total coal used (pounds),	5,081,095
Gallons pumped per pound of coal,	2,704.63
Average lift (feet),	39.07
Cost of pumping: —	
Labor,	$18,469 74
Fuel,	8,491 03
Repairs,	1,217 83
Oil, waste and packing,	275 39
Small supplies,	135 65
Total,	$28,589 64
Cost per million gallons pumped,	$2.0804
Cost per million gallons raised 1 foot high,	.0532

Compared with the corresponding figures for the year 1912 the quantity pumped at both stations was 3,749,110,000 gallons less; the coal used 2,455,602 pounds less; the total cost of pumping $6,389.61 less, and the cost of labor $981.27 less.

The greater part of the pumping for the southern high service has been done by Engine No. 12 at Station No. 2, and advantage has been taken of the opportunity to make repairs at Station No. 1 which could not have been conveniently done with the engines in operation at that station. The maple floor in the old portion of the engine room, built by the city of Boston in 1887, has been replaced by a floor composed of 9-inch x 9-inch Welsh tiles, laid on a bed of concrete reinforced with expanded metal of a pattern known as "Self-sentering." The expanded metal, concrete and tile form a layer about 3 inches in thickness which rests upon the old hard pine floor beams which supported the wooden floor. The cost of this floor, covering 4,000 square feet, including the removal of the old floor, was as follows: —

Penn Metal Co., "Self-sentering,"	$255 78
L. L. Rinaldi & Co., Welsh tiles,	737 82
Samuel Shaw & Co., laying tiles,	415 93
Cement, sand, ironwork, etc.,	261 80
Labor by maintenance force,	694 67
Total,	$2,366 00
Cost per square foot,	$0.591

The toilet fixtures used in connection with the superintendent's office, which were of obsolete pattern and in poor condition, have been replaced by modern fixtures at a cost of $233.57.

The site of this pumping station was filled to a depth of from 10 to 15 feet about the year 1866, when Chestnut Hill Reservoir was built, with stumps and other material of a perishable nature. When the station was built the walls of the building and the engine foundations were carried down to solid ground, but the boiler foundations and the floors of the boiler room and engine room basement were supported on the filled land. From time to time during the past fifteen years it has been found necessary to place more solid foundations under the boilers, and during the past year about 765 square feet of the concrete floor of the engine room basement, which had badly settled and cracked, has been removed and replaced with a new concrete floor. The toilet room in this part of the basement has been repaired and rearranged, and the old wooden lockers used by the employees have been replaced by 22 portable steel lockers each 18 x 18 x 72 inches. The cost of these changes was as follows: —

Labor and materials used in connection with floor and drains,	$482 69
Slate and plumbing work,	153 35
Steel lockers, including cost of assembling,	163 77
	$799 81

The foundation of the economizer and the floor of the boiler room are badly settled, and it is planned to repair them during the coming year.

A new locker room and lavatory was completed and placed in service at Pumping Station No. 2 on April 8, 1913. This room is 30 feet 2 inches long, 14 feet 11 inches wide, and 11 feet 2 inches high. It is located in the coal house, the walls of which form two sides of the room, the other sides being made of ferrolithic plates secured to a steel framework and plastered on both sides to give a total thickness of 2 inches. The floor is of concrete 4 inches thick, with a granolithic surface, and plastered on the underside. The ceiling is composed of ferrolithic plates and cement mortar, 2 inches in thickness. The room contains 3 shower baths, 3 vitreous china lavatories and 32 steel lockers, each 18 x 18 x 72 inches. Ventilation for the room is provided by an 8-inch galvanized iron pipe connected into the space between the flue and the outer wall of the main chimney. This ventilator pipe has inlets, controlled by dampers at both the top and bottom of the room. The cost of this room and fittings was as follows: —

Structural steel furnished and erected by the Smith Erecting & Contracting Co.,	$420 00
Ferrolithic plates and mason work, Robert Gallagher Company,	540 00
Plumbing and slate work, H. W. Orr Company,	355 25
Ventilating pipe, F. E. Woodward & Co.,	14 00
Hardware, lumber, floors and windows,	81 89
Labor, carpenters and laborers from maintenance force,	215 89
Labor, pumping station employees, steam piping, electric wiring, placing ventilating pipe, painting, etc.,	144 08
32 Durand steel lockers, including erection,	234 40
	$2,005 51

The lowest of several bids received on August 30, 1912, for the construction of this room was $2,690, and this bid did not include the cost of the steel lockers and other items given above, amounting in the aggregate to $358.40, so that by rejecting the first bids, subdividing the work between several contractors, and doing a portion of the work with our own employees, a saving of over $1,000 was effected.

A contract has been made with the Green Fuel Economizer Company of Matteawan, N. Y., for the reconstruction of the economizer which was installed at Station No. 2 when the station was built. The reconstructed parts were received at the station during the last week in the year.

The steel channel beams which support the track in the coal house have been covered with concrete, and the concrete has been carried about 2 feet higher than formerly around the steel columns, in order to protect them from corrosion by the bituminous coal.

During May the entire woodwork of both pumping stations, with the exception of the monitors on the roof of Station No. 2, was painted one coat, and the doors were painted two coats. All the interior woodwork in the engine rooms, office and toilet rooms, except the ceilings, was cleaned and given a coat of varnish, and a considerable part of the surface was given two coats. The cost of this work was $645.30.

Spot Pond Pumping Station.

The following are statistics relating to operations at this station, where water is pumped to the Fells and Bear Hill reservoirs for the supply of the northern high-service district: —

Total quantity pumped (gallons),	2,600,880,000
Daily average quantity pumped (gallons),	7,126,000
Total coal used (pounds),	2,230,505
Gallons pumped per pound of coal,	1,166.05
Average lift (feet),	127.41
Engine No. 8 operated (hours),	58
Engine No. 9 operated (hours),	3,104
Quantity pumped by Engine No. 8 (gallons),	24,990,000
Quantity pumped by Engine No. 9 (gallons),	2,575,890,000

Cost of pumping: —	
Labor,	$8,970 15
Fuel,	4,176 06
Repairs,	386 19
Oil, waste and packing,	259 67
Small supplies,	176 44
Total for station,	$13,968 51
Cost per million gallons pumped,	5.3707
Cost per million gallons raised 1 foot high,	.0422

There has been a reduction in the cost of fuel and repairs, and the cost per million gallons raised one foot high shows a slight reduction. The exterior wood finish of the pumping station has been painted and the interior finish varnished by the C. P. Hicks Company of Malden for $300. Early in the year a new floor, composed of 3-inch hard pine plank, was laid in the coal house by the pumping station employees, at a cost of $192.90, including both stock and labor.

Arlington Pumping Station.

The statistics relative to the operation of this station for the year 1913 are as follows: —

Total quantity pumped (gallons),	247,580,000
Daily average quantity pumped (gallons),	678,000
Total coal used (pounds),	914,775
Gallons pumped per pound of coal,	270.65
Average lift (feet),	283.54
Engine No. 10 operated (hours),	5,301
Engine No. 11 operated (hours),	435
Quantity pumped by Engine No. 10 (gallons),	234,960,000
Quantity pumped by Engine No. 11 (gallons),	12,620,000

Cost of pumping: —	
Labor,	$5,610 08
Fuel,	1,857 46
Repairs,	194 20
Oil, waste and packing,	88 15
Small supplies,	141 71
Total for station,	$7,891 60

Cost per million gallons pumped,	$31.8749
Cost per million gallons raised 1 foot high,	.1124

The total cost of operating the station was less than in 1912, but the quantity pumped was also less, and the cost per million gallons raised one foot high was increased.

West Roxbury and Hyde Park Pumping Stations.

On January 16 one of the engines at the new Hyde Park pumping station was started, and at the same time the pumps at the West Roxbury station were stopped. Since that date all water pumped for the southern extra high service has been pumped at the Hyde Park station, except during 9 hours and 35 minutes on April 27, while work was in progress on the main through which water is supplied to the Hyde Park station.

The following statistics of cost and work include the operations at both stations: —

	Hyde Park Pumping Station.	West Roxbury Pumping Station.	Combined Stations.
Total quantity pumped (gallons),	279,550,000	13,335,000	292,885,000
Daily average quantity pumped (gallons),	-	-	802,000
Total coal used (pounds),	627,884	56,047	683,931
Gallons pumped per pound of coal,	445.23	237.93	428.24
Average lift (feet),	123.40	130.48	-
Engine No. 13 operated (hours),	3,809	-	-
Engine No. 14 operated (hours),	2,648	-	-
Quantity pumped by Engine No. 13 (gallons),	163,680,000	-	-
Quantity pumped by Engine No. 14 (gallons),	115,870,000	-	-
Cost of pumping: —			
Labor,	-	-	$5,956 21
Fuel,	-	-	1,317 76
Repairs,	-	-	349 49
Oil, waste and packing,	-	-	134 66
Small supplies,	-	-	363 81
Total for station,	-	-	$8,121 93
Cost per million gallons pumped,	$26.7088	$49.1541	$27.7308
Cost per million gallons raised 1 foot high,	.2164	.3767	-

CONSUMPTION OF WATER.

The daily average quantity of water consumed in the eighteen municipalities supplied from the Metropolitan Works during the year 1913, as measured by Venturi meters, was 103,847,700 gallons, equivalent to 94 gallons per capita in the district supplied. The daily average consumption was 12,383,000 gallons less than during the previous year, somewhat less than during any year since 1901, and less per capita than in any year since 1895.

The daily average consumption of water in each of the cities and towns supplied from the Metropolitan Works during the years 1912 and 1913, as measured by meters, was as follows: —

	Estimated Population, 1913.	Daily Average Consumption.				
		1912.		1913.		Decrease in Gallons.
		Gallons.	Gallons per Capita.	Gallons.	Gallons per Capita.	
Boston,	733,360	90,037,500	125	79,390,600	108	10,646,900
Somerville,	82,810	6,427,500	79	5,956,000	72	471,500
Malden,	47,890	2,226,300	48	2,225,700	46	600
Chelsea,	35,820	2,935,500	82	2,879,800	80	55,700
Everett,	37,300	2,707,800	73	2,435,800	65	272,000
Quincy,	35,530	3,003,100	87	2,699,100	76	304,000
Medford,	25,650	1,222,900	49	1,233,700	48	10,800[1]
[illegible]	16,640	1,132,100	69	1,136,600	68	4,500[1]
[illegible]	20,720	1,495,400	73	1,385,100	67	110,300
[illegible]	14,060	922,300	67	868,500	62	53,800
[illegible]	12,550	1,075,500	89	786,300	63	289,200
[illegible]	8,470	343,300	41	332,300	39	11,000
[illegible]	11,440	717,400	65	689,700	60	27,700
[illegible]	7,830	590,700	78	414,400	53	176,300
[illegible]	6,320	434,500	71	463,600	73	29,100[1]
[illegible]	5,400	356,800	68	359,300	67	2,500[1]
[illegible]	1,380	158,800	120	169,100	123	10,300[1]
[illegible]	6,640	443,300	68	420,100	63	23,200
	1,109,810	116,230,700	107	103,847,700	94	12,383,000

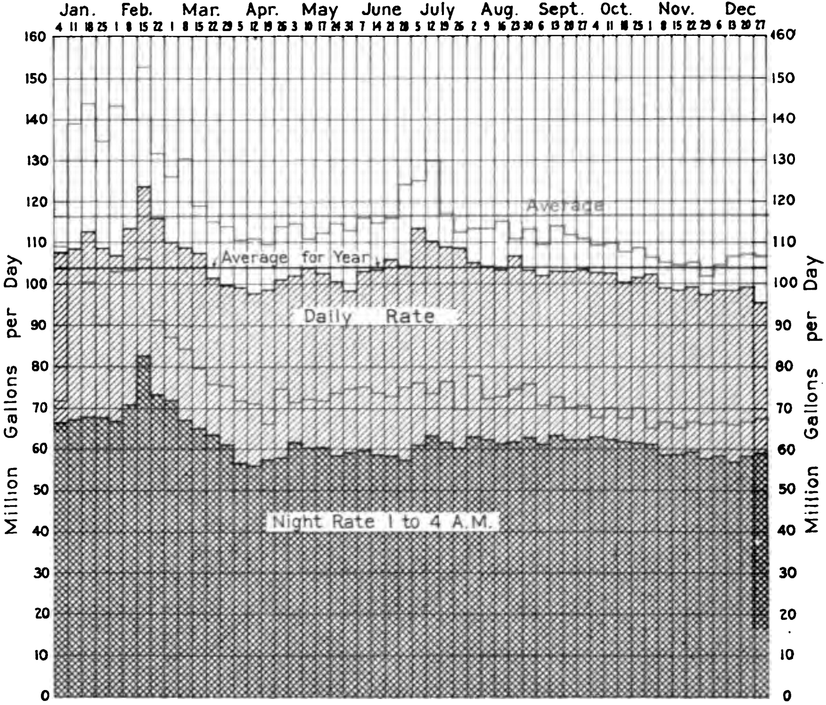
[1] Increase.

[illegible] consumption in the several districts was as follows: —

	Gallons per Day, 1913.	Decrease Gallons per Day.	Percentage of Decrease.
[illegible] the low-service district of [illegible] and East Boston,	[illegible]	[illegible]	[illegible]
[illegible] the low-service districts [illegible] Everett, Arlington, [illegible]	[illegible]	[illegible]	16.73
[illegible] Quincy and Watertown [illegible] portions of [illegible]	[illegible]	[illegible]	[illegible]
[illegible] Melrose, Revere, [illegible] Medford, Everett and [illegible]	[illegible]	[illegible]	5.34
[illegible] the higher portions [illegible]	[illegible]	[illegible]	[illegible]
[illegible] Lexington and the [illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	10.65

AVERAGE RATE OF CONSUMPTION
IN
METROPOLITAN WATER DISTRICT
AND
RAINFALL AND AVERAGE TEMPERATURE OF AIR AT CHESTNUT HILL RESERVOIR
FOR
EACH WEEK DURING 1913

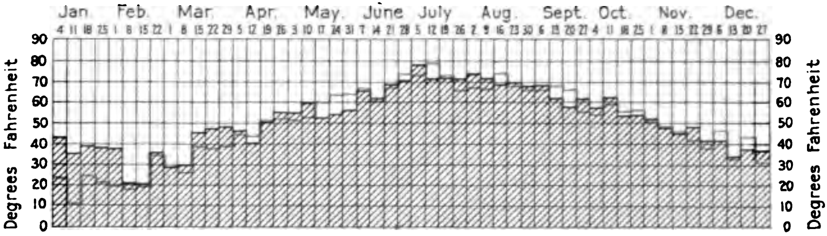
CONSUMPTION AND NIGHT RATE



RAINFALL IN INCHES

1.75	1.41	0.23	0.42	0.67	0.60	0.24	1.01	1.09	0.29	1.49	0.61	2.56	0.69	2.22	1.61	0.13	0.49	0.04	0.40	2.20	0.82	0.42	0.00	0.26	0.36	0.00	0.69	0.50	0.30	1.43	0.25	0.86	1.32	1.46	1.01	0.17	1.31	0.58	0.89	0.28	2.24	2.67	0.40	0.23	0.71	0.45	1.30	0.00	1.25	0.00	2.08

AVERAGE WEEKLY TEMPERATURE



Averages for 1912 shown in Red.

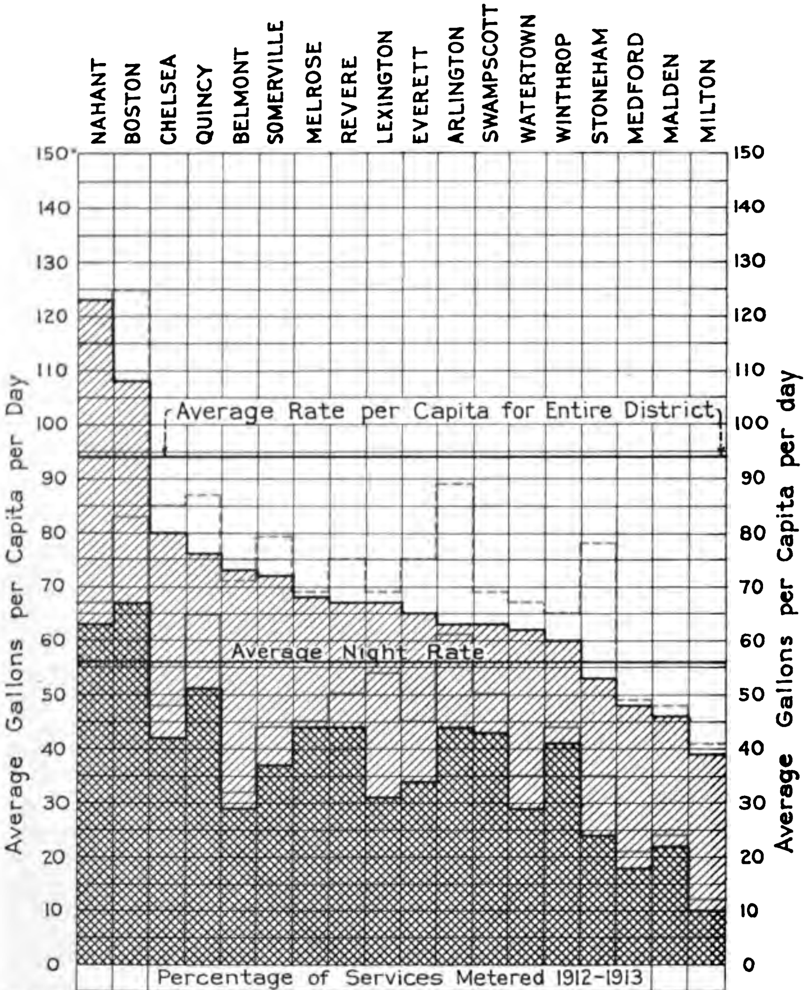
DIAGRAM SHOWING

AVERAGE RATE OF CONSUMPTION OF WATER IN THE METROPOLITAN DISTRICT IN 1913

DURING THE ENTIRE DAY

AND

BETWEEN THE HOURS OF 1 AND 4 AT NIGHT



Percentage of Services Metered 1912-1913

	NAHANT	BOSTON	CHELSEA	QUINCY	BELMONT	SOMERVILLE	MELROSE	REVERE	LEXINGTON	EVERETT	ARLINGTON	SWAMPSCOTT	WATERTOWN	WINTHROP	STONEHAM	MEDFORD	MALDEN	MILTON
Dec.31,1912	57.0	34.8	97.7	75.0	100.0	56.9	100.0	42.5	78.3	33.9	93.0	100.0	100.0	100.0	73.6	100.0	96.0	100.0
Dec.31,1913	59.8	41.4	98.4	85.0	100.0	61.3	100.0	50.0	79.3	39.7	100.0	100.0	100.0	100.0	75.4	100.0	99.3	100.0

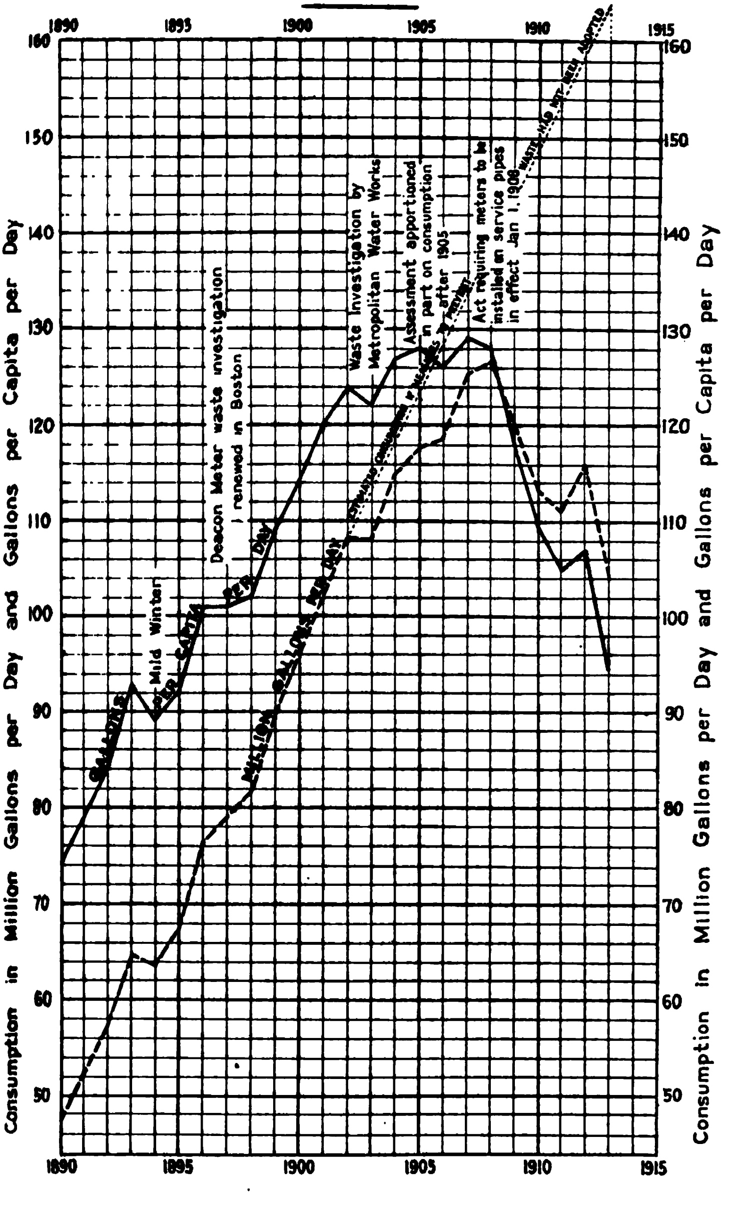
Daily Average Rate of Consumption 1913.................. ▨
" " " Night between 1 A.M. and 4 A.M. 1913.. ▩
Daily Average Rate of Consumption in 1912 shown in Red

In 13 of the 18 municipalities supplied the consumption was less than in 1912. The large reduction in the quantity used as compared with that of the previous year was due, largely, to two causes, — the more general use of meters and the unusually mild weather during the winter of 1912–1913. It will be seen from an inspection of the diagram facing page 70, that the consumption during the summer months was from 5,000,000 to 12,000,000 gallons less than for the corresponding time in the previous year, while the consumption during January and February was about 25,000,000 gallons per day less in 1913 than in 1912. The average temperature of the air for these winter months was 32° in 1913 as compared with 22° in 1912.

The diagram facing this page shows the average daily per capita use and the rate of use between the hours of 1 and 4 A.M. in the several municipalities. The average daily rates varied from 39 gallons in the town of Milton to 123 gallons in the town of Nahant, but the per capita use in Nahant is very large during the summer, for the reason that the town has a very large summer population, for which no allowance is made in the census population, upon which the per capita consumption is based. The average daily per capita consumption in the cities of Boston and Medford and the towns of Winthrop and Stoneham for the year 1913 was less than the average rate of use in the same municipalities between the hours of 1 and 4 A.M. during the year 1908, indicating that the total daily use is now less than the use and waste during the night hours before the more general introduction of meters.

The diagram on page 72 shows graphically the changes which have taken place in the total and per capita use of water since the year 1890, in the district now supplied from the Metropolitan Works. From 1890 to 1902 the quantity used increased very rapidly, and it seems probable that if no means had been adopted to restrict the waste of water, the consumption of the Metropolitan District would, at the present time, be 60,000,000 gallons per day greater than it now is, and that the District would be expending several million dollars in procuring an additional supply of water.

DIAGRAM SHOWING
CONSUMPTION OF WATER
IN THE
METROPOLITAN WATER DISTRICT
AS SUPPLIED IN 1913
FROM 1890 TO 1913



Metering of Service Pipes.

The placing of meters on all new services and on 5 per cent. of those unmetered on December 31, 1907, in conformity with chapter 52 of the Acts of the year 1907, has been continued during the year, and the following table shows the results accomplished in the several municipalities: —

CITY OR TOWN.	Number of Meters required to be set on Old Services Each Year.	METERS SET ON OLD SERVICES.						New Services installed, 1913.[1]	New Services equipped with Meters, 1913.[1]	Services in Use December 31, 1913.	Meters in Use December 31, 1913.	Per Cent. of Services metered December 31, 1913.
		1908.	1909.	1910.	1911.	1912.	1913.					
Boston, . .	4,276	84	5,503	5,481	6,487	6,022	5,600	1,489	1,888	100,626	41,654	41.39
Somerville, .	411	732	621	501	570	488	508	255	255	12,827	7,856	61.25
Malden, . .	14	43	62	8	2	-	2	114	112	7,568	7,512	99.26
Chelsea, . .	240	198	756	779	1,092	132	33	86	86	4,768	4,693	98.43
Everett, . .	252	338	255	277	285	215	235	109	134	5,686	2,260	39.75
Quincy, . .	230	358	33	423	1,680	1,090	647	396	609	8,564	7,381	86.19
Medford, . .	179	857	927	1,555	178	6	7	301	303	5,091	5,073	100.00
Melrose, . .	119	2,432	135	7	5	-	-	95	95	3,784	4,041	100.00
Revere, . .	138	85	184	110	176	154	157	245	233	3,971	1,985	49.99
Watertown, .	-	-	-	-	-	-	-	166	192	2,417	2,425	100.00
Arlington, . .	55	108	56	63	127	261	349	132	132	2,409	2,438	100.00
Milton, . .	-	-	-	-	-	-	-	91	91	1,678	1,678	100.00
Winthrop, . .	100	213	975	706	6	-	-	85	81	2,740	2,667	100.00
Stoneham, . .	65	116	225	186	155	252	189	46	43	1,544	1,337	86.59
Belmont, . .	-	-	-	-	-	-	-	115	115	1,242	1,242	100.00
Lexington, . .	32	113	70	56	86	95	4	103	88	1,063	843	79.30
Nahant, . .	16	30	40	26	18	17	4	33	33	620	371	59.84
Swampscott, .	21	264	142	28	13	-	-	75	75	1,702	1,702	100.00
Totals, . .	6,148	5,971	9,984	10,206	10,880	8,732	7,735	3,936	4,565	168,300	97,158	57.61

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[1] The number of new meters installed and the number of new services equipped with meters seldom agree exactly for the reason that service pipes are installed but meters are not set until the buildings are permanently occupied.

During the year there was a net increase of 11,798 in the number of meters in use, and at the end of the year 57.61 per cent. of the 168,300 services in use were provided with meters. In ten of the municipalities practically all of the services are now metered.

WATER SUPPLIED OUTSIDE THE METROPOLITAN DISTRICT.

During the year 1913, 385,927,200 gallons of water were supplied by the Metropolitan Works for use outside the Metropolitan Water District, as follows: —

PLACES SUPPLIED.	Total Quantity (Gallons).	Average Daily Quantity (Gallons).	Times during which Water was supplied.	Amounts charged for Water supplied.
Westborough State Hospital, . .	60,904,000	167,000	- -	$1,827 12
Town of Framingham: —				
From Framingham Reservoir No. 3, .	6,700,000	18,356	May, 4 days, . . July, 22 days, . . August, 9 days, . . September, 1 day, . October, 2 days, . . November, 10 days, . December, 26 days, .	160 80
From Filter-gallery at Farm Pond, .	276,300,000	756,984	- -	529 89
United States Government: — Peddock's Island, ...	37,262,000	102,100	- -	2,336 58
Town of Saugus, ...	4,761,200	13,000	- -	280 00

QUALITY OF WATER.

About 82 per cent. of the water used in the Metropolitan District during the year was drawn from the Wachusett Reservoir; the remainder from the Sudbury Reservoir, Framingham Reservoir No. 3 and Lake Cochituate. The water delivered from the taps has had less color, and the results of both chemical and biological examinations compare favorably with those of previous years. Weekly microscopical and bacterial examinations have been made in the laboratory of the Board, and chemical examinations have been furnished by the State Board of Health. There have been made 2,422 microscopical and 1,105 bacterial examinations of the water from various parts of the works, and the results of 392 chemical examinations have been received from the State Board of Health.

The results of the examinations of water drawn from a tap in Boston for alternate years since 1897 are given in the following table, and tables giving further details of the chemical and biological examinations will be found in Appendix No. 2.

	1897.	1899.	1901.	1903.	1905.	1907.	1909.	1911.	1913.
STATE BOARD OF HEALTH EXAMINATIONS.									
Color (platinum standard),	0.55	0.28	0.29	0.29	0.24	0.22	0.18	0.25	0.13
Total residue,	4.82	3.70	4.43	3.98	3.86	3.83	3.46	4.18	3.96
Loss on ignition,	1.84	1.30	1.64	1.50	1.59	1.40	1.43	1.66	1.15
Free ammonia,	0.0009	0.0006	0.0013	0.0013	0.0020	0.0013	0.0011	0.0015	0.0014
Albuminoid ammonia, total,	0.0193	0.0136	0.0158	0.0125	0.0145	0.0129	0.0128	0.0156	0.0150
Albuminoid ammonia, dissolved,	0.0177	0.0122	0.0143	0.0110	0.0124	0.0109	0.0103	0.0128	0.0120
Albuminoid ammonia, suspended,	0.0016	0.0014	0.0015	0.0015	0.0021	0.0020	0.0025	0.0029	0.0026
Chlorine,	0.40	0.24	0.30	0.30	0.35	0.33	0.28	0.38	0.35
Nitrogen as nitrates,	0.0137	0.0137	0.0173	0.0142	0.0083	0.0068	0.0034	0.0029	0.0064
Nitrogen as nitrites,	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
Oxygen consumed,	0.64	0.35	0.42	0.39	0.35	0.32	0.25	0.33	0.26
Hardness,	1.6	1.1	1.7	1.5	1.4	1.3	1.3	1.4	1.5
METROPOLITAN WATER AND SEWERAGE BOARD EXAMINATIONS.									
Color (platinum standard),	0.59	0.32	0.34	0.35	0.28	0.27	0.23	0.22	0.16
Turbidity,	–	–	2.0	2.2	1.9	2.2	2.6	2.2	1.9
Total organisms,	351	192	243	286	528	427	1,959	735	410
Amorphous matter,	177	201	38	36	37	47	97	76	80
Bacteria,	105	117	162	126	231	176	195	197	140

NOTE.—Chemical analyses are in parts per 100,000, organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter. The standard unit has an area of 400 square microns, and by its use the number of Diatomaceæ are decreased, and the number of Chlorophyceæ and Cyanophyceæ are very much increased, as compared with the number of organisms.

A small growth of Synura appeared in the Wachusett Reservoir in October, which gave a faintly oily odor to the water, but this lasted only a few days, and with this exception the water in the reservoir was free from objectionable tastes and odors throughout the year.

Dinobryon, Uroglena and Synura were present in small numbers in the Sudbury Reservoir throughout the year, but not in sufficient numbers to cause objectionable odors. A growth of Chlamydomonas appeared in this reservoir in August and continued until early in October, giving the water at times a faintly or distinctly disagreeable odor.

A growth of Uroglena appeared in Framingham Reservoir No. 3 about the middle of June, lasted two weeks, and gave a faintly oily odor to the water. A growth of Chlamydomonas appeared in this reservoir late in September and caused the water to have a faintly to distinctly disagreeable odor during the month of October. This organism continued in the water in smaller numbers until the end of the year.

No water was drawn from Framingham Reservoir No. 2, or the Ashland, Hopkinton and Whitehall reservoirs for the supply of the District. With the exception of Whitehall Reservoir, where there were growths of Uroglena, Synura and Dinobryon during February and March, all of these reservoirs have been free from growths of objectionable organisms. The color of the water in these reservoirs has varied from 27 to 186, while that of the water drawn from the Sudbury Reservoir and Framingham Reservoir No. 3, for use in the District, has had an average color of 13.

A large growth of Aphanizomenon was present in Lake Cochituate throughout the year, and the water had a disagrèeable odor the greater portion of the time. A distinctly oily taste and odor was given to the water of the lake during the month of May by a growth of Uroglena.

Small growths of Uroglena, Chlamydomonas, Dinobryon and Synura have occurred in the several distributing reservoirs and for short periods have given the waters a slightly unpleasant taste, but very few complaints of the quality of the water furnished have been received.

SANITARY INSPECTION.

William W. Locke, with two assistants, has been continuously employed in inspecting the premises, 9,150 in number, on the several watersheds, and in taking such action as necessary to enforce the rules and regulations relative to the pollution of the water supply. Special inspectors have been employed during the summer season to see that the regulations of the Board relative to bathing, boating and fishing were obeyed. For the greater portion of the time from June 21 to November 1 the Boston & Albany Railroad was engaged in widening the bridge and roadbed which cross Framingham Reservoir No. 2, near Ashland, and during this time an inspector was kept on the ground to see that precautions were taken to prevent pollution of the supply. The expense of this inspection, amounting to $491.36, is to be paid by the railroad. Twenty-five permits to cut ice for private use were granted at the Waushacum Ponds, in Sterling, and at the Framingham and Sudbury reservoirs, Waushakum and Dudley ponds, Whitehall Reservoir and Sudbury River, and the work of cutting and harvesting the ice was inspected.

For violating the rules relative to fishing and bathing, thirteen persons were summoned into court and fined from $2 to $5 each, and the fishing permits given to ten other persons were revoked.

The results of the inspection of the watersheds are given in the following tables: —

Summary of Sanitary Inspections on the Wachusett Watershed in 1913.

DISTRICT.	Number of Premises inspected.[1]	CLASSIFICATION OF CASES INSPECTED.													CONDITION AT END OF YEAR.		WATER SUPPLY.		
		Cesspools dug before 1913.	Cesspools dug during 1913.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	INDIRECT SINK DRAINAGE.		BARN DRAINAGE.		Manufacturing Wastes.	Premises Vacant.	No Drainage.	Drainage carried to Filter-beds.	Satisfactory.	Unsatisfactory.	Premises having Public Water Supply.	Premises supplied by Private Wells, Cisterns, etc.	Premises on which no Water is used.
							Satisfactory.	Unsatisfactory.	Satisfactory.	Unsatisfactory.									
French Brook,	64	31	2	-	-	-	29	-	25	1	-	6	1	-	63	1	8	55	1
Muddy Brook,	39	14	1	-	-	-	20	-	22	-	-	2	-	1	39	-	-	38	1
Gates Brook,	182	116	9	-	1	-	44	2	52	-	-	7	2	-	180	2	-	176	6
Malden Brook,	32	14	1	-	-	-	15	-	23	-	-	2	1	-	32	-	-	31	1
Chaffin Brook,	196	102	4	-	-	-	71	7	87	-	1	8	1	-	189	7	78	113	5
Asnebumskit Brook,	284[2]	162	4	1	3	16	61	8	84	2	3	25	5	2	257	27	193	79	12
Muschopauge,	91	29	2	-	-	1	48	-	41	1	1	11	1	-	88	3	5	82	4
South Wachusett Brook,	86	34	1	1	-	1	38	-	47	1	-	9	3	-	84	2	-	83	3
Trout Brook,	35	4	-	-	-	-	23	-	26	-	1	5	-	-	34	1	-	33	2
East Wachusett Brook,	214	76	4	1	-	3	96	3	100	3	-	16	3	1	205	9	-	204	10
Stillwater River,	142	54	-	-	-	-	69	2	74	2	-	5	2	1	139	3	-	136	6
Waushacum,	171[3]	67	4	-	1	3	75	2	57	3	-	5	5	91	164	7	-	164	7
French Hill,	33	21	-	-	-	-	10	-	13	-	-	1	1	-	33	-	-	32	1
Totals,	1,569	724	32	3	5	24	599	24	651	13	6	102	25	96	1,507	62	284	1,226	59

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[1] On some premises there are two or more cases.

[2] Not including 11 summer cottages at Asnebumskit Pond.

[3] Not including 216 summer cottages at Waushacum Lakes.

Summary of Sanitary Inspections on the Sudbury and Cochituate Watersheds in 1913.

DISTRICT.	Number of Premises inspected.[1]	CLASSIFICATION OF CASES INSPECTED.														CONDITION AT END OF YEAR.	
		Sewer Connections.	Cesspools dug before 1913.	Cesspools dug during 1913.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	INDIRECT SINK DRAINAGE.		BARN DRAINAGE.		Manufacturing Wastes.	Premises Vacant.	No Drainage.	Drainage carried to Filter-beds.	Satisfactory.	Unsatisfactory.
								Satisfactory.	Unsatisfactory.	Satisfactory.	Unsatisfactory.						
SUDBURY WATERSHED.																	
Farm Pond,	304	292	5	-	-	-	-	-	-	18	-	-	8	7	-	304	-
Framingham Reservoir No. 3,	90	-	46	1	-	-	-	37	-	40	1	-	6	2	-	89	1
Stony Brook,	302	-	225	9	-	1	-	38	2	117	4	-	11	12	1	296	6
Angle Brook,	1,989	1,589	251	3	-	1	1	102	3	225	2	-	37	16	1,796	1,984	5
Framingham Reservoirs Nos. 1 and 2, and Cold Spring Brook,	326	-	202	9	-	-	-	91	2	97	-	-	5	6	-	324	2
Eastern Sudbury,	223	-	190	3	-	-	-	26	3	36	-	-	10	11	-	220	3
Indian Brook,	413	-	203	1	-	1	2	149	12	72	4	-	27	14	-	396	17
Western Sudbury,	186	-	92	4	-	2	-	63	9	65	2	1	6	9	-	176	10
Whitehall Reservoir,	112	-	29	-	-	-	-	62	2	34	2	-	12	4	-	109	3
Cedar Swamp,	805	529	165	2	-	2	-	66	11	132	1	-	39	14	-	793	12
COCHITUATE WATERSHED.																	
Snake Brook,	185	-	127	3	-	1	-	44	1	44	1	-	15	3	-	184	1
Pegan Brook,	1,019	734	215	1	-	-	-	42	-	93	-	-	18	9	980	1,019	-
Course Brook,	98	2	68	8	-	-	-	18	-	43	-	-	6	2	-	98	-
Beaver Dam Brook,	1,529	1,076	306	30	-	7	1	63	13	164	3	-	25	20	1	1,513	16
Totals,	7,581	4,222	2,124	74	-	15	4	801	58	1,180	20	1	225	129	2,777	7,505	76

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[1] On some premises there are two or more cases.

On the Wachusett watershed there has been a decrease in the number of premises where the sanitary conditions are not entirely satisfactory, notwithstanding an increase in the total number of premises. The increased activity at the industrial plants on this watershed mentioned in the report for 1912 has continued, and 12 plants, employing over 400 persons, have been in operation throughout the year. The Dawson Mill, in Holden, with 75 employees, began operations in January. Studies for the disposal of the manufacturing wastes from the mills, as well as the house sewage from the town of Holden, have been in progress throughout the year.

At the settlement on Gates Brook, in West Boylston, where about sixteen small houses have been built during the past eight years on a swampy area on which it is very difficult to maintain proper sanitary conditions, there has been little change during the year. One dwelling has been built and one destroyed by fire. One house formerly occupied during the summer only is now occupied throughout the year, and two houses are now being enlarged. The improvement of conditions on this area is now under consideration.

Improvements in sanitary conditions have been made as follows: a cesspool has been constructed by the Board on the premises of M. H. Ferguson, in West Boylston, to receive the sink and water-closet drainage, which at certain seasons of the year was liable to reach a small stream which ultimately enters the reservoir. Two additional filter-beds have been built at the Mount Pleasant House in Holden by the owner of the property, and one of the old beds has been resurfaced with gravel.

There has been comparatively little change in the sanitary conditions on the Sudbury River watershed. There has been an increase of 19 in the total number of premises, and a decrease of 12 in the number of those in which the sanitary conditions are considered unsatisfactory.

On the Cochituate watershed the industrial growth and consequent increase in building has been less rapid than for the two years previous, yet there has been a considerable increase in the number of premises.

Five gravel filter-beds, each 50 feet x 50 feet, have been added by the owners of the Deerfoot Farm factory, at Southborough, to the 6 beds previously used, and 4 concrete septic tanks have been constructed through which all wastes from the factory are carried before being applied to the filter-beds.

The gas works in Marlborough have not been operated since early in 1913, the city now being supplied from works in South Framingham. Short extensions have been made to the public sewers in Westborough and Marlborough, and 13,530 feet of main and street sewers have been built in Framingham.

In the city and towns on the Sudbury and Cochituate watersheds which have systems for conveying sewage outside the watersheds, the number of premises connected with the sewers has been increased by 128, and the number existing on streets where sewers have been built has been reduced from 102 to 99. The number in the several places on December 31, 1913, was as follows: —

	Premises connected with Sewers.		Premises not connected with Sewers.	
	1912.	1913.	1912.	1913.
Marlborough,	1,560	1,589	55	45
Westborough,	526	529	15	12
Framingham,	1,280	1,363	4	17
Natick,	723	734	28	25
Sherborn,	5	7	-	-
Totals,	4,094	4,222	102	99

All cases of typhoid fever which have been reported as occurring on the several watersheds have been carefully watched and measures taken to prevent the spread of the disease or contamination of the supply. Eleven cases were reported on the Wachusett watershed, 5 of which were from Sterling, 1 from Princeton, 3 from Holden and 2 from Boylston. Nineteen cases were reported on the Sudbury and Cochituate watersheds, 9 of which were from Marlborough, 6 from Hopkinton, 2 from Ashland, 1 from Framingham and 1 from Wayland.

SWAMP DITCHES AND BROOKS.

The ditches, 36.36 miles in length, which have been constructed and are maintained by the Board on the several watersheds for the purpose of improving the quality of the water, have been cleaned and the weeds and brush cut and burned for a width of from 10 to 20 feet alongside the ditches. Ditches in the O'Brien swamp in Westborough, and the Baker and McHale swamps in Southborough, tributary to the open channel of the Wachusett Aqueduct, have been repaired by renewing the board bottoms of the ditches and reshaping and repairing the slopes for a distance of 6,979 feet at a cost of $646.06. Three thousand four hundred and twenty-nine feet of wire fence have been erected, at a cost of $357.70, alongside ditches through pasture land of C. E. Leland, in Southborough, for the purpose of keeping cattle from the ditches, except at two watering places.

Ditches on Angelico Brook, which drains into Framingham Reservoir No. 3, and the ditches on Broad Meadow and Mowry brooks, which drain into the Sudbury Reservoir, have been repaired by renewing the board bottom for a distance of 2,353 feet and repaving 10,440 square feet of the side slopes.

The cost of repairing the 8.9 miles of ditches on the Sudbury watershed was $1,034.37, not including the cost of the lumber, which had been on hand for several years.

The colors of the waters from the several swamps which have been ditched were somewhat higher than for several previous years.

Protection of the Supply by Filtration.

The several filter-beds which are maintained by the Board for the purpose of purifying the water collected in the streams before its admission into the storage reservoirs have been maintained as usual. The Marlborough Brook filter-beds, having an area of 14 acres, on which is filtered the water received from about 2 square miles of the more thickly settled portions of the city of Marlborough, received and filtered the entire flow of the brook. The artificial beds, 5.36 acres in area, were cleaned in July and again in October, and the natural beds were cleaned during the latter part of June and early in July. The filter-beds on Farm Street received diluted sewage from the overflow of the Marlborough main sewer during 5 days in March and 9 in April.

At the Pegan Brook pumping station, where the surface drainage from an area of about 1 square mile in the thickly settled portion of the town of Natick is pumped upon filter-beds before entering Lake Cochituate, the pumps were operated during portions of 226 days, and 325,102,000 gallons, equivalent to a daily average of 890,690 gallons, were pumped to the filter-beds. This was the entire flow of Pegan Brook and all the flow from the intercepting ditch, with the exception of about 6,000,000 gallons which flowed from the ditch directly into the lake during 4 days in March and 1 in April. The amount of coal used was 208,667 pounds, and 1,558 gallons were pumped per pound of coal. The cost of operating the pumping station, maintaining the filter-beds, building and grounds was $3,414.37, making the cost per million gallons treated $10.50, or $1.08 less than in 1912.

The 4 filter-beds, with a combined area of 2 acres, on which was received the flow from 525 acres in the village of Sterling, treated the entire flow from the brook.

The filter-beds on which the sewage from the Worcester County Training School is received and treated have been cared for and have operated satisfactorily throughout the year.

The Gates Terrace filter-beds at Sterling Junction, on which is received the drainage from a few small cottages, were operated from April 5 to November 1.

FORESTRY.

Around the Wachusett Reservoir 125,000 3-year-old white pine seedlings have been planted on 95 acres of land on which the pines previously planted were destroyed by fire in 1911 and 1912. For greater protection from fire in the future the new plantations have been so made that the planted areas, covering from 15 to 30 acres, are surrounded by open lanes 45 feet in width. About 1,500 3-year-old white pine seedlings were set out on old spoil banks along the open channel portion of the Wachusett Aqueduct in Marlborough and Southborough.

At the Sudbury Reservoir 64,170 white pines were planted on about 50 acres, also 4,000 white pines along the Weston Aqueduct, as follows: 300 west of Edgell Street, at Nobscot; 2,600 near siphon chamber No. 3; 150 on the east side of the aqueduct opposite the Cochituate and Wayland road; 750 on the south side of the aqueduct east of the road from Cochituate to Wayland, and 200 west of School Street in Wayland.

At the Weston Reservoir 518 cedar trees have been planted in double rows on each side of the open channel, and 56 pines and 31 cedars on the dam near the screen chamber.

At Spot Pond 785 white pines have been set out at different points, the greater number being on the south and east sides of the pond.

In April and May the State Forester's department furnished 300,000 white pines and 100,000 spruce seedlings, all one year old.

These were planted in nurseries at Oakdale, near the Wachusett Reservoir, and at the Sudbury Reservoir in Southborough, for use in planting during the coming year.

The Oakdale nursery has been enlarged from 1.4 to 3.9 acres, and at the close of the year contained: —

6,200	4-year-old white pine seedlings. transplanted twice.
800	3-year-old white pine seedlings, transplanted twice.
25,000	3-year-old white pine seedlings, transplanted once.
165,500	2-year-old white pine seedlings, transplanted once.
38,600	2-year-old white pine seedlings, in seed beds.
36,300	2-year-old white spruce seedlings, transplanted once.
200	2-year-old sequoia seedlings, transplanted once.
200	1-year-old red pine seedlings, in seed beds.

The nursery at the Sudbury Reservoir covers 2 acres, and contained at the end of the year: —

130,000	2-year-old white pine seedlings, transplanted once.
3,200	3-year-old white pine seedlings, transplanted twice.

After an examination of the chestnut trees on different parts of the works, and the consideration of reports from other parts of the country regarding the chestnut bark disease, it was deemed expedient in 1912 to begin the cutting of chestnut trees which gave unmistakable signs of being affected by the disease. During the winter of 1912 and 1913 a force of from 8 to 15 men was employed in cutting the trees on 48 acres of the west shore of Andrews harbor at the Wachusett Reservoir, 25 acres of which were covered with a growth of chestnut trees from 25 to 40 years old, 12 acres with a growth of chestnut, maple and oak sprout and 11 acres with a growth of maple, oak, pine and chestnut about 25 years old. The 25-acre parcel has been cleared and the chestnut trees cut from the 11-acre parcel. The clearing of the 12-acre parcel is now in progress and about 4 acres had been cleared at the end of the year. About 3 acres were cleared from a 28-acre parcel on the north side of the reservoir near the line between the towns of Boylston and West Boylston, on which there was a growth of oak and chestnut from 15 to 20 years old. The chestnut trees were cut on 7½ acres near the Oakdale nursery at West Boylston. Other areas around this reservoir where there were chestnut trees were inspected, and trees showing advanced signs of the disease were cut. During the past summer all chestnut trees were inspected, and as it appeared that the bark disease was not developing as rapidly as was feared, work in the future is to be confined to the removal of trees which are affected with the disease beyond a reasonable doubt, except on areas where the work has been partially done. This work was resumed on November 3, and at the end of the year about 2,830 trees from 4 to 15 inches in diameter had been cut on 610 acres of land. The following table gives a summary of the work done in connection with the chestnut bark disease, the cost of same and the approximate value of the telephone poles, railroad ties, fence posts and cord wood obtained: —

SEASON OF —	Location.	Area cleared (Acres).	Area treated (Acres).	Cost.	Products.	Approximate Receipts.
1912-1913,	Lots 148A, B and C,	25	-	$4,500	Poles, ties, fence posts, cord wood.	$4,900
	Lot 106A, . .	3	-	345	Chair logs, cord wood, .	207
	Lot 44B, . .	7.5	-	305	Cord wood, . . .	79
	General, . . .	-	-	194	Poles, ties, cord wood, .	13
1913-1914,	Lot 148B, . .	4	-	415	Cord wood, . . .	75
	General, . . .	-	610	1,092	Poles, ties, cord wood, .	503

A 6¾-acre lot near Sterling Junction, on which the trees were partially burned in May, 1911, has been cleared at a cost of $332, from which is to be deducted $232 for wood sold. The dead trees, stumps and brush were cleared from 8 acres of land at Big Crane Swamp, from which E. W. Wheeler & Son had cut the timber. The cost of this work was $475, less a credit of $85 for wood sold. The work of cutting the standing trees on about 105 acres in Big Crane Swamp has been continued by E. W. Wheeler & Son of Berlin, but the contractor has experienced difficulty in keeping men on the work and but little progress has been made during the year.

The protection of the trees from the ravages of destructive insects has necessitated the expenditure of the following sums: —

Spot Pond, ...	$1,275 40
Mystic Lake, ...	53 00
Chestnut Hill Reservoir, ...	526 74
Weston Reservoir, ...	923 79
Sudbury, Cochituate and Weston aqueducts, ...	976 18
Lake Cochituate, ...	468 32
Sudbury Reservoir, ...	2,137 33
Framingham Reservoirs Nos. 1, 2 and 3 and Whitehall Reservoir, .	262 65
Wachusett Reservoir and aqueduct, ...	2,724 16
	$9,347 57

In addition to the above sums there has been expended $5,574.15 for two Fitzhenry-Guptill spraying machines and $700 for 2,000 feet of 1-inch hose used in connection with same. The machine in the Wachusett Department is motor driven and so arranged that the tank and pump can be removed and the machine used as a motor truck when desired. This machine cost $4,465.32, including truck and body. The machine used in the Sudbury Department is horse drawn and cost $1,187.15. Judging from the results obtained by the use of the horse-drawn spraying machine, purchased in 1911 and used by the Distribution Department, the use of these machines will reduce the cost and increase the efficiency of the spraying work during the coming year.

In the Distribution Department the egg clusters of the gypsy moth were destroyed during the fall and winter by painting with a creosote mixture, and the webs or nests of the brown-tail moth were cut from the trees and burned. The trees on 150 acres were sprayed between May 28 and June 21, using 8,300 pounds of arsenate of lead in the proportion of 1 pound of lead to 10 gallons of water.

Fifty-six gallons of creosote mixture were used in this department in painting egg clusters. The elm trees were twice sprayed for the purpose of destroying the elm-leaf beetle.

In the Sudbury Department considerable work has been done along the lines of the Sudbury, Cochituate and Weston aqueducts in cutting and pruning out undesirable trees and brush and burying stones, all of which were infested with the eggs of the gypsy moth. Clusters of the eggs of the gypsy moth were destroyed on different parts of the Sudbury and Cochituate works as follows: —

Sudbury Aqueduct,	11,800
Cochituate Aqueduct,	58,900
Weston Aqueduct,	20,700
Lake Cochituate,	3,900
Sudbury Reservoir,	49,400
Framingham Reservoirs Nos. 1, 2 and 3,	2,100
Near Rocklawn Mills on Sudbury River,	500
	147,300

The spraying machine was used from May 26 to July 7 on infested areas at the Sudbury Reservoir, Framingham Reservoirs Nos. 1, 2 and 3, Lake Cochituate and at several points along the Weston Aqueduct as far east as siphon chamber No. 2. Trees which could not be conveniently reached by the power sprayer were sprayed by using a hand pump. The area sprayed was approximately 450 acres, and 7,100 pounds of arsenate of lead were used. The cost of spraying, including the material used, was $1,240.80.

In the Wachusett Department comparatively few gypsy moths have been found, but still in sufficient numbers to occasion considerable concern lest they become as numerous as they have on other portions of the works. The eggs have been creosoted wherever found, and webs and nests of the brown-tail moth were cut from trees along the line of the open channel of the Wachusett Aqueduct, on the grounds at the dam and along the roads about the Wachusett Reservoir, but no attempt was made to pick them from the woodland in general. Between 5,000 and 6,000 trees on about 440 acres covering substantially the same areas as those given above were sprayed with 4,600 pounds of arsenate of lead at a cost, including the material used, of $1,005.13.

The young white pines on 1,247 acres of the marginal lands around the Wachusett Reservoir, as well as those around the Sudbury Reservoir, were inspected, and the shoots found to be infested with the pine-tree weevil were cut off and burned. The number of infested shoots was less than in previous years. The tent caterpillar was more prevalent than for several years past, and large numbers of the nests were burned.

Thirty-two fires were reported during the year as occurring on lands of the Board at various points. In seventeen cases the cause was reported as sparks from a locomotive, and in only one instance was more than slight damage done. This fire occurred on April 23, when sparks from a locomotive started a fire which burned over about 8 acres of land on the shore of the Stillwater Basin at West Boylston, and destroyed 10,000 white pines from 2 to 3 feet high.

DISTRIBUTING RESERVOIRS.

The water collected and stored in the reservoirs on the several watersheds has been conveyed to and delivered from the following reservoirs and standpipes located in or near the Metropolitan District.

	Capacity in Gallons.
Spot Pond, Stoneham and Medford,	1,791,700,000
Chestnut Hill Reservoir, Brighton district of Boston,	300,000,000
Weston Reservoir, Weston,	200,000,000
Fells Reservoir, Stoneham,	41,400,000
Mystic Reservoir, Medford,	26,200,000
Fisher Hill Reservoir, Brookline,	15,500,000
Waban Hill Reservoir, Newton,	13,500,000
Forbes Hill Reservoir, Quincy,	5,100,000
Bear Hill Reservoir, Stoneham,	2,450,000
Arlington Standpipe, Arlington,	550,000
Forbes Hill Standpipe, Quincy,	330,000
Total,	2,396,730,000

Weston Reservoir.

The grounds and structures connected with this reservoir have received the customary care and are in good condition.

Chestnut Hill Reservoir.

In addition to the ordinary care of the grounds the walks surrounding the reservoir have been resurfaced with stone dust for a distance of about three-quarters of a mile; the driveway between the two basins has been repaired and oiled, and 20 pine and spruce trees planted. The cost of inspection and police work on the grounds about the reservoir was $591.51.

Waban Hill Reservoir.

The reservoir has been in constant service, has received the customary care and is in good condition.

Fisher Hill Reservoir.

This reservoir came under the control of this department on September 5. The reservoir and gate-house are generally in good condition, although some repairs will be necessary to the screens and stop-planks during the coming year. The grounds have received but little care during recent years, and the maintenance force is now engaged in trimming the trees, destroying moths and cutting underbrush.

Forbes Hill Reservoir and Standpipe.

The granolithic walk which surrounds this reservoir has been cracked for several years and will probably soon require repairs. The standpipe is in good condition.

Mystic Reservoir.

The embankments have been given a dressing of manure and the roadways resurfaced with stone dust. A woman was drowned in the reservoir on September 15, and the water was shut off from the remainder of the system until December 29.

Mystic Lake.

The fishway at the Mystic Lake Dam has been lengthened about 25 feet so as to reach the water in the lower lake. This was made necessary by the permanent lowering of the lower lake by the Metropolitan Park Commission.

Spot Pond.

The exterior and interior woodwork of the gate-houses has been painted, also the floors and other ironwork in the interior. The cable used between the pumping station at Spot Pond and the gate-house at Bear Hill, in operating the telephone and recording gages, which had been injured by electrolytic action, has been temporarily repaired. About 250 feet of 10-inch drain pipe has been laid on Main Street on the west side of the pond, connecting with Dark Hollow Pond three catch basins which receive surface drainage from the roadway. About 3,000 feet of footpath has been graded and partially surfaced with screened ashes. The cost of inspection and police work at the pond during the year was $1,110.

Fells and Bear Hill Reservoirs.

The woodwork of the gate-house at each of these reservoirs was painted. The Bear Hill Reservoir was emptied and thoroughly cleaned between April 15 and 18. The spraying machine was used in washing the sides and bottom of the reservoir, aided by workmen with push brooms, in removing mud from the bottom. The sides and bottom were given a wash of cement and marble dust. A considerable growth of Potamogeton, or pond weed, and Anachoris, or American water weed, was found on the bottom of this reservoir.

PIPE YARDS.

The buildings at the Chestnut Hill and Glenwood pipe yards are in good condition. A new concrete floor has been placed in the blacksmith shop and in a portion of the open shed at the Glenwood pipe yard, and the driveways have been resurfaced with crushed stone.

PIPE LINES.

No additional mains have been laid during the year, but the length of the mains owned and operated by the Metropolitan Water and Sewerage Board has been increased by the purchase from the city of Boston of 14.41 miles of large pipes, nearly all of which are in the town of Brookline and the city of Somerville. The length controlled by the Board on December 31, 1913, was 116.10 miles, and the length of mains 4 inches in diameter and larger connected with the works, but owned and operated by the several cities and towns supplied with water, 1,779.01 miles.

Fox Hill Bridge.

The work of relaying a portion of the 16-inch water pipe leading to Nahant and Swampscott was made necessary by the reconstruction of the bridge crossing the Saugus River between Saugus and Lynn. This work was begun in 1912 and was referred to in the last annual report. At the end of 1912 the pipe line laid upon a temporary bridge was still in use, and no work had been done on the permanent line. Early in May the laying of 16-inch pipes on the concrete shelf which was constructed for that purpose on the north side of the bridge was begun, and continued as rapidly as the construction of the bridge permitted, but it was not until June 25 that the final connection was made on the permanent line. The pipe is now supported on a concrete shelf alongside the new bridge for a distance of 200 feet, and passes under the channel at the draw in an inverted siphon, with the top of its horizontal portion 14 feet below Boston City Base. For a distance of about 200 feet on the Saugus side of the river the old bridge has been replaced by solid filling, but the water pipe is still supported by a pile foundation and enclosed in a double wooden box. The side of this box next to the street has been protected by a covering of cement reinforced with wire netting.

The total cost of the changes in the water pipe made necessary by the reconstruction of the bridge was $6,548.56, of which $2,600 was expended in 1912 and the remainder during the past year.

Relaying 24-inch Main on Broadway in Chelsea.

It had been known for several years that the 24-inch pipe on Broadway, in Chelsea, was being destroyed by electrolytic action, and money was provided in the yearly appropriation for relaying a portion of this main if found necessary. Investigation, following a leak which occurred July 19, showed that the pipe should be relaid at once, and work was begun August 4 and finished October 18. The portion relaid extended from near Williams Street to Chelsea North bridge, a distance of 1,379.4 feet. The condition of the pipe taken up is given elsewhere in this report, under the head of Electrolysis. The pipe was originally 0.81 of an inch in thickness, but the pipe used in relaying is 1.03 inches thick, and nearly all of the joints have been made with wood instead of lead, for the purpose of preventing injurious electrolytic action in the future. The cost of this work to December 31, 1913, was $7,384.74, to which will be added during the coming year the cost of repaving the trench with granite blocks laid in cement on a concrete foundation.

Anderson Bridge.

The construction of the masonry arch bridge over the Charles River between Cambridge and Brighton, in place of the pile structure, in which there was a draw opening, made it possible to carry the water pipes over the river instead of under the river bed, and as the two 36-inch mains which cross the river at this point were known to be deteriorated by electrolytic action it was decided to lay pipes over the bridge. The pipes and special castings required for the work have been obtained. The pile foundation required on the Cambridge side of the river has been built, and 146.4 feet of 48-inch and 121.6 feet of 36-inch pipe laid. The pile foundation was prepared and some of the labor in connection with laying the pipes was furnished by the Holbrook, Cabot & Rollins Corporation. The amount expended on account of this work to December 31, 1913, was $4,951.49.

Connection with Mains of the City of Malden for Emergency Use.

In order that water may be supplied to Revere, Winthrop, Swampscott, Nahant and the higher portions of Chelsea and Everett, at times when the main upon which these districts depend for their supply is out of service at a point in Malden where it passes under the Saugus Branch Brook and the Saugus Branch of the Boston & Maine Railroad, a connection has been made between the 30-inch main and a 12-inch pipe of the city of Malden, by means of which the municipalities beyond the point of connection can be supplied in case it becomes necessary to shut off the Metropolitan main. This connection was made between October 22 and November 6 at a cost of $1,074.24.

Check Valve at Winthrop.

A 12-inch check valve has been installed at the Revere-Winthrop line, so that in case of an accident to the Metropolitan main the water in the standpipe in Winthrop will be retained for the use of that town.

Miscellaneous.

The supply main leading from the terminus of the Weston Aqueduct toward Chestnut Hill Reservoir, which was laid in 1902 and 1903, has been cleaned for a distance of 6,800 feet, at a cost of $384.25, or $0.056 per foot. The tubercles were removed from the interior of the pipe by laborers using wood and iron scrapers, and the pipe was then washed by the use of the spraying machine, using a jet from a ¼-inch diameter nozzle under a pressure of 200 pounds per square inch. The lighter material was washed out of the blow-offs, and 45 cubic feet of the heavier material, composed principally of tubercles, was removed in pails.

The concrete-lined tunnel and steel pipe on Section 7 of the 60-inch supply pipe line in Newton has been drained, cleaned and inspected, and a few shrinkage cracks in the concrete lining repaired by calking with lead wool.

An Akron pipe drain 8 inches in diameter and 375 feet long, has been laid from a blind well located west of Loring Street, in Weston, and following the 60-inch pipe line crossing Loring and River streets, to another blind well provided with an overflow. The object of this drain is to divert water collected by the 60-inch pipe trench from the street gutter on Loring and River streets. This work cost $468.23.

The boxing around the pipes at bridges over the Fitchburg Railroad at Webster Avenue, in Somerville, and the Boston & Albany Railroad at St. James Street, in Newton, was cleaned, repaired and painted, and the boxing at the College Avenue bridge over the Boston & Lowell Railroad, in Medford, and the Massachusetts Avenue bridge over the Fitchburg Railroad, in Cambridge, has been repaired.

Leaks.

There have been 56 leaks and 3 breaks in the mains during the year, costing for repairs and damages $3,411.29.

More than half this sum was paid on account of a break in the 48-inch main at the junction of Clinton and Dean roads, in Brookline, on December 4, 1913. The pipe line in which this break occurred was laid by the city of Boston in 1869, and had previously broken several times. At the time of the last break a piece of iron 31.6 square feet in area was blown from the side of one of the pipes, and water flowed from the opening at the rate of about 80,000,000 gallons per day for nearly two hours, while the gates controlling the flow of water were being closed. This great volume of water washed away the surface of the streets and excavated holes from 3 to 5 feet deep in the neighboring lawns, entered the basements of several houses and slightly undermined the rails of the Brookline Branch of the Boston & Albany Railroad at a point 2,500 feet away from the break. The cost of repairing the pipe, which was done by the maintenance force, was $554.02; the labor and materials used in repairing private property, also furnished by the maintenance force, was $530.55; the cost of repairing streets, the work being done by the town of Brookline, was $259.23; and the amount paid for injury done to personal property by water entering houses was $541.15, a total of $1,885.05. It will be necessary to reseed some of the lawns, plant shrubs and relay some of the walks during the coming spring.

A small leak from a joint in one of the 24-inch pipes which cross over the subway in Harvard Square, Cambridge, continued for several months and caused considerable expense before it was located and repaired. The water from this leak passed up and then over the subway, and appeared in the basement of the building occupied by the Harvard Co-operative store, at a distance of about 75 feet from its source. The cost of tracing this leak and making repairs was $294.26.

A leak from a joint in the 30-inch high-service main on Main Street, in Malden, at a point where the main passes under Saugus Branch Brook and is 11 feet below the surface of the street, was repaired on June 29 at a cost of $300.73. The difficulty in repairing this leak, on account of its location, called attention to the desirability of making the connection with the Malden pipe system, which was afterward made and is described elsewhere in this report.

On July 3 and 4 an increase of pressure in the form of water hammer developed on the southern high-service system, extending over that system from the pumping station at Chestnut Hill to West Roxbury and Quincy. The concussion was so great on the force mains near the Fisher Hill Reservoir that it caused leaks from 12 joints and necessitated shutting off the main. The exact cause of the water hammer was not determined, but it is thought to have been due to the action of the pumping engines in connection with air in the pipes.

Fourteen of the 56 leaks repaired have occurred at wooden joints, and in most cases were caused by settlement of the pipes.

The 24-inch cast-iron main on Temple Street, Somerville, was on November 18 found to be split, caused by settlement on to a stone which rested on a ledge. The cost of repairing this leak was $266.71, due largely to difficulty in locating the broken pipe.

METERS.

There are now 71 Venturi meters connected with the works. Four of these are at the Wachusett Dam and are used in measuring water drawn from the Wachusett Reservoir. Two are located on the pipes leading from the Sudbury Dam and are used for measuring water drawn from the Sudbury Reservoir and delivered into the Weston Aqueduct. Sixty-five are on connections through which water is supplied to the different municipalities. There are also 3 Hersey disc meters, 1 Hersey torrent meter and 5 Hersey detector meters used in measuring small quantities which cannot be conveniently measured with meters of the Venturi type. The work of caring for the meters in the Metropolitan District has been done by two men, assisted at times by a third. The cost of the work connected with the reading, operating and maintaining of these meters has been $1,974.38.

RECORDING GAGES.

Twenty-two recording gages have been maintained for the purpose of continuously indicating and recording at different points the water pressure existing in the Metropolitan mains. The records from these gages, together with those from gages maintained by the cities and towns, often prove of much value in fixing the time when breaks in the mains occur, as well as the loss of pressure due to same; also the loss of pressure due to abnormal drafts and other facts of interest. Table No. 44 in Appendix No. 2 gives the average results of observations made during the year. In general, the water pressure throughout the Metropolitan District was slightly greater than during the previous year.

ELECTROLYSIS.

As stated elsewhere in this report it has been found necessary to take up a 24-inch main in Chelsea, which had been in use 25 years, on account of its destruction by electrolytic action. It is noticeable that in every case where the Metropolitan mains have been laid in streets passing power stations of the electric railroads they have been destroyed by electrolytic action. Five hundred ninety-three feet of 12-inch pipe in Washington Street, Lynn, near the power station of the Bay State Street Railway, was relaid in 1904, after having been in use six years. Eight hundred twenty-seven feet of 48-inch pipe in Boylston Street, Cambridge, near the power station of the Boston Elevated Railway, was relaid in 1910, after fourteen years' use, and the 24-inch pipe relaid during the past year, in Chelsea, passes the power station of the Bay State Street Railway, which has been in operation since 1892. Examinations of this pipe made during previous years have shown that the pipes were being steadily deteriorated, and the leak which occurred in July indicated that the pipe could not be longer continued in use with safety. When removed from the trench the iron from the pipe, combined with the material in which the pipes were laid, was found to have formed a coating around the pipe from 2 to 3 inches in thickness, and sufficiently hard to require the use of picks for its removal, while the pipes could be cut with a knife to a depth of from one-quarter to three-quarters of an inch. In removing the pipes from the trench and cleaning them, 145 holes from three-quarters of an inch to 3 inches in diameter were made through the pipes.

The amount expended since January, 1904, for relaying three mains which have been destroyed by electrolytic action has been $20,681.50.

No material change in the electrical conditions on the Metropolitan Water Works pipe lines has been observed during the year.

CLINTON SEWAGE DISPOSAL WORKS.

The Clinton sewage disposal works were operated daily throughout the year. The daily average quantity of sewage pumped to the filter-beds was 1,008,000 gallons, which was 49,000 gallons per day less than in 1912, but still largely in excess of the quantity pumped in other previous years. The large quantity of sewage pumped during the last two years was due in great measure to the leaky condition of the sewers in Clinton, and to the fact that a number of rain-water conductors from buildings have been connected with the sewers. By-laws have recently been adopted by the town which forbid such connections being made in the future. The daily average quantity pumped during each month of the year was as follows: —

	Gallons.
January,	1,186,000
February,	1,015,000
March,	1,315,000
April,	1,598,000
May,	1,094,000
June,	946,000
July,	783,000
August,	734,500
September,	761,000
October,	859,000
November,	860,000
December,	950,000

Pumping Station.

The following are statistics relating to the operation of the pumping station: —

Daily average quantity of sewage pumped (gallons),	1,008,000
Daily average quantity of energy consumed (kilowatt hours),	312
Daily average quantity of coal consumed, in burning sludge and heating (pounds),	257
Gallons pumped per kilowatt hour,	3,230
Daily average lift of sewage (feet),	49.1
Daily average efficiency of pumping unit (per cent.),	56.1
Number of days pumping,	365

Cost of pumping: —

Labor,	$1,342 51
Energy (at $5.30 per thousand kilowatt hours),	603 82
Fuel, coal for burning sludge and heating,	227 64
Repairs and supplies,	321 30
Total for station,	$2,495 27
Cost per million gallons pumped,	$6.780
Cost per million gallons raised 1 foot high,	.138

Substantially all of the pumping was done with the 12-inch motor-driven centrifugal pump, which has operated very satisfactorily. When new the pump showed an average efficiency of between 58 and 60 per cent., but as the protecting rings in the casing and impeller became worn the efficiency fell to 48 per cent. After five months' use of the pump the substitution of new rings, at a cost of $32.34, restored the pump to its original efficiency, and the new moving parts being made of cast iron instead of brass have thus far given better results than the rings first used.

The cost of operating the station, using the centrifugal pump, shows a marked saving when compared with the cost when the sewage was pumped with the steam-driven Blake plunger pump. The cost of doing the work during the past year was $1,493.17 less than in 1912, and about $560 or 18 per cent. less than the average cost during the previous thirteen years.

The lawns, driveway and walks about the pumping station have been resurfaced and the lawns reseeded.

Filter-beds.

Sewage was applied to the filter-beds in substantially the same manner as during the preceding 5½ years. The 8 settling basins into which the sewage is pumped previous to being applied to the filter-beds were used in pairs in rotation throughout the year. During the winter season the basins were used continuously for a month, but from April 1 to December 1 they were emptied and cleaned after one week's use. Each of the 25 1-acre beds has received about 70,000 gallons of sewage in a period of 30 minutes at intervals of 1.7 days, equivalent to about 40,300 gallons per acre per day. During the winter season the surface of the beds was plowed in furrows 3½ feet apart. Of the sludge collected in the basins 568 cubic yards have been used on grass land on the back slope of the North Dike and on the lawns about the Wachusett Dam, and 182 cubic yards have been piled near the filtration area for future use. The following tabulation shows the results of the analyses of the sewage and effluent for the past year as compared with those for previous years: —

[Parts per 100,000.]

	Average of Four Years, 1906-09.	1910.	1911.	1912.	1913.		Whole Year, 1913.
					January to June.	July to December.	
Albuminoid ammonia, sewage,	.7540	.7050	1.0683	1.6017	1.1550	1.2500	1.2025
Albuminoid ammonia, effluent,	.0768	.0686	.0639	.0724	.0440	.0298	.0369
Per cent. removed,	89.7	90.3	94	95	96	98	97
Oxygen consumed, sewage,	7.045	6.658	9.3292	11.812	9.567	9.067	9.317
Oxygen consumed, effluent,	1.085	.8863	.8713	.5170	.6006	.4067	.5037
Per cent. removed,	83.5	86.7	91	95.5	94	96	95
Free ammonia, sewage,	4.1617	3.8867	5.7417	4.2129	3.8300	4.7867	4.3083
Free ammonia, effluent,	1.3134	.6493	.7369	.6709	.2906	.0677	.1792
Per cent. removed,	67.5	83.3	87	84	92	99	96
Nitrogen as nitrates, effluent,	.1724	.7338	.9740	.8638	.9682	1.9972	1.6542
Iron, effluent,	1.9807	.6395	.5203	.3779	.1106	.0287	.0696

The effluent from the beds has improved continuously since 1909 and the results obtained during the past year have been better than any previously obtained and compare very favorably with those obtained on other filtration areas in the Commonwealth. The cost of maintaining the filter-beds has been as follows: —

Labor,	$3,812 34
Supplies and expenses,	160 31
Total,	$3,972 65
Cost per million gallons treated,	$10 80

HYDRO-ELECTRIC POWER STATION.

The hydro-electric power station at the Wachusett Dam was operated on 276 days during the year, and nearly all of the electric energy developed was delivered to the Connecticut River Transmission Company under a five-year contract, which went into effect on October 2, 1911. The daily output has varied from the minimum amount which the Transmission Company is required to take under its contract to the full capacity of the plant, which is about 70,000 kilowatt hours when the generators are operated continuously. The plant has operated satisfactorily and there have been no interruptions worthy of note. The following are the statistics relative to the operation of the station: —

Quantity of energy sold to Connecticut River Transmission Company (kilowatt hours),	6,098,729
Quantity of energy used at power station (kilowatt hours),	14,278
Quantity of energy used at Sewerage Pumping Station (kilowatt hours),	113,928
Total quantity of energy generated (kilowatt hours),	6,226,935

Quantity of water used (gallons),	28,527,600,000
Average effective head (feet),	90.6
Kilowatt hours generated per million foot gallons,	2.409
Efficiency of station (per cent.),	76.7

Earnings: —		
Energy supplied Connecticut River Transmission Company at $5.30 per thousand kilowatt hours,	$32,323 28	
Labor supplied Connecticut River Transmission Company,	93 50	
Energy supplied power and sewerage pumping stations, credited at $5.30 per thousand kilowatt hours,	679 49	
		$33,096 27
Cost of operating station: —		
Labor,	$5,375 26	
Fuel for heating building,	94 03	
Repairs and appliances,	363 72	
Oil and waste,	51 79	
Small supplies,	129 95	
Taxes,	2,975 00	
		8,989 75
Net earnings,		$24,106 52
Net earnings per thousand kilowatt hours generated,		$3 87

ENGINEERING.

In addition to supervising the work already described in this report, the engineering force investigated and prepared estimates for work required for supplying the town of Braintree with water, including the construction of a reservoir in the Blue Hill park reservation; surveys, plans and estimates of cost have been prepared for caring for the waste waters from the mills at Quinepoxet, Jefferson and Dawsonville, the sewage from the towns of Holden and West Boylston, and the water of Gates Brook, which receives some objectionable drainage from a settlement in West Boylston near the Worcester line; plans and estimates of cost of swimming pools in the towns of Ashland and Hopkinton were made for the information of legislative committees; plans and estimates have been prepared for widening the roadway at the point where Cedar Street passes under the Cochituate Aqueduct in the town of Wellesley; surveys and plans have been made of land which the Board proposes to acquire around Framingham Reservoir No. 3, and surveys, plans and reports have been made relative to numerous petitions received for the use of land on different parts of the works.

Appended to this report are tables giving the amount of work done and other information relative to contracts, a series of tables relating to the maintenance of the Metropolitan Water Works, including the rainfall, yield of sources of supply, consumption of water in the different districts, the number of service pipes, meters and fire hydrants in the Metropolitan Water District, and a summary of statistics for the year 1913.

Respectfully submitted,

DEXTER BRACKETT,
Chief Engineer.

BOSTON, January 1, 1914.

690522

REPORT OF THE ENGINEER OF SEWERAGE WORKS.

To the Metropolitan Water and Sewerage Board.

GENTLEMEN: — The following report of the operations of the Metropolitan Sewerage Works for the year ending December 31, 1913, is respectfully submitted: —

ORGANIZATION.

The Engineer has charge of the design and construction of all new works, and of the maintenance and operation of all the works controlled by the Metropolitan Water and Sewerage Board for removing sewage from the twenty-four municipalities which comprise the Metropolitan Sewerage districts.

The Engineer has had the following assistants: —

HENRY T. STIFF,	*Division Engineer, in charge of office and drafting room and of construction of the new Mystic sewer, North Metropolitan System.*
CLARENCE A. MOORE,	*Assistant Engineer, in charge of maintenance studies and records.*
ARTHUR F. F. HASKELL,	*Assistant Engineer, in charge of survey work and field work in connection with the new Mystic sewer construction.*

In addition to the above, the average number of engineering and other assistants employed during the year was 13, which includes 2 instrumentmen, 4 inspectors, 2 draftsmen, 3 rodmen and 2 stenographers.

METROPOLITAN SEWERAGE DISTRICTS.

AREAS AND POPULATIONS.

During the year no changes have been made in the extent of the sewerage districts as given in the last annual report.

The populations of the districts, as given in the following table, are based on the census of 1910.

Table showing Areas and Estimated Populations within the Metropolitan Sewerage Districts, as of December 31, 1913.

	City or Town.	Area (Square Miles).		Estimated Population.	
North Metropolitan District.	Arlington,	5.20		12,760	
	Belmont,	4.66		6,440	
	Boston (portions of),	3.45		108,380	
	Cambridge,	6.11		110,100	
	Chelsea,	2.24		36,360	
	Everett,	3.34		37,900	
	Lexington,[1]	5.11		4,410	
	Malden,	5.07		48,420	
	Medford,	8.35		26,040	
	Melrose,	3.73		16,780	
	Revere,	5.86		21,090	
	Somerville,	3.96		83,670	
	Stoneham,	5.50		7,960	
	Wakefield,	7.65		12,260	
	Winchester,	5.95		10,150	
	Winthrop,	1.61		11,630	
	Woburn,	12.71		16,150	
			90.50		570,490
South Metropolitan District.	Boston (portions of),	24.96		220,890	
	Brookline,	6.81		30,800	
	Dedham,[1]	9.40		9,730	
	Milton,	12.59		8,550	
	Newton,	16.88		43,130	
	Quincy,	12.56		35,970	
	Waltham,	13.63		30,070	
	Watertown,	4.04		14,350	
			100.87		393,390
	Totals,		191.37		963,880

[1] Part of town.

METROPOLITAN SEWERS.

SEWERS PURCHASED AND CONSTRUCTED AND THEIR CONNECTIONS.

During the year there has been built 2.46 miles of Metropolitan sewer within the sewerage districts, so that there are now 105.886 miles of Metropolitan sewers. Of this total, 9.642 miles of sewers, with the Quincy pumping station, have been purchased from cities and towns of the districts, the remaining 96.244 miles of sewers and other works having been constructed by the Metropolitan boards.

The locations, lengths and sizes of these sewers are given in the following tables, together with other data referring to the public and special connections with the systems: —

NORTH METROPOLITAN SEWERAGE SYSTEM.

Location, Length and Sizes of Sewers with Public and Special Connections.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1913.	Special Connections. Character or Location of Connection.	Special Connections. Number in Operation.
Boston: —					
Deer Island,	6′ 3″ to 9′ 0″,	1.367	4	–	–
East Boston,	9′ 0″ to 1′ 0″,	5.467	25	Shoe factory, Middlebrook Wool-combing Co.,	1 1
Charlestown,	6′ 7″×7′ 5″ to 1′ 0″,	3.292	14	Navy Yard, Almshouse, Private building,	8 1 1
Winthrop,	9′ 0″,	2.864	12	Club house, Fire Department Station, Private building,	1 1 1
Chelsea,	8′ 4″×9′ 2″ to 1′ 10″×2′ 4″,	5.123	12	Bakery, Rendering works, Metropolitan Water Works blow-off, Chelsea Water Works blow-off,	1 1 1 2
Everett,	8′ 2″×8′ 10″ to 4′ 8″×5′ 1″,	2.925	7	Metropolitan Water Works blow-off, Cameron Appliance Co., Shults-Goodwin Co., Andrews-Wasgatt Co., National Metallic Bed Co., Linoide Co., Factory,	1 1 1 1 1 1 1
Malden,	4′ 6″×4′ 10″ to 1′ 0″,	5.844[1]	31	Metropolitan Water Works blow-off, Private buildings,	1 167
Melrose,	4′ 6″×4′ 10″ to 10″,	6.099[2]	36	Private buildings, Factory, Railroad station,	111 1 1
Cambridge,	5′ 2″×5′ 9″ to 1′ 3″,	7.209	39	Park Department bath house, Harvard dormitories, Slaughterhouse, City Hospital, Street railway machine shop, Tannery, Slaughterhouses (3), Car-house,	1 1 1 3 1 1 1 1
Somerville,	6′ 5″×7′ 2″ to 1′ 3″,	3.577	10	Somerville Water Works blow-off, Street railway power house, Stable, Rendering works, Railroad scale pit, Armory building,	1 1 1 1 1 1
Medford,	4′ 8″×5′ 1″ to 10″,	5.359	23	Private buildings, Stable, Police substation, Tannery,	8 1 1 4
Winchester,	4′ 6″ to 1′ 3″,	8.830	14	Private buildings, Gelatine factory, Stable, Railroad station,	4 1 1 1
Stoneham,	1′ 3″ to 10″,	0.010	4	–	–
Woburn,	1′ 10″×2′ 4″ to 1′ 3″,	0.933	3	Glue factory,	1
Arlington,	1′ 6″ to 10″,	3.520[3]	38	Private buildings, Railroad station, Car-house, Post office,	141 1 3 1

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[1] Includes 1.84 miles of sewer purchased from the city of Malden.

[2] Includes .736 of a mile of sewer purchased from the city of Melrose.

[3] Includes 2.631 miles of sewer purchased from the town of Arlington.

Location, Length and Sizes of Sewers with Public and Special Connections — Concluded.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1913.	Special Connections.	
				Character or Location of Connection.	Number in Operation.
Belmont,[1] . .	– –	–	3	– –	–
Wakefield,[1] . .	– –	–	1	– –	–
Revere, . . .	4′ 0″ to 3′ 0″, . . .	0.048	2	– –	–
		62.467[2]	278		402

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[1] The Metropolitan sewer extends but a few feet into the towns of Belmont and Wakefield.

[2] Includes 2.787 miles of Mystic valley sewer in Medford, Winchester and Woburn, running parallel with the Metropolitan sewer.

South Metropolitan Sewerage System.

Location, Length and Sizes of Sewers with Public and Special Connections.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1913.	Special Connections.	
				Character or Location of Connection.	Number in Operation.
Boston: —					
Back Bay, . .	6′ 6″ to 3′ 9″, . . .	1.500[1]	14	Tufts Medical School, . . Private house, . . . Administration Building, Boston Park Department, Simmons College buildings, . Art Museum, ...	1 1 1 1 2
Brighton, . .	5′ 9″×6′ 0″ to 12″, . .	6.010[2]	14	Abattoir, ...	3
Dorchester, . .	3′×4′ to 2′ 6″×2′ 7″, . .	2.870[3]	13	Chocolate works, . . . Machine shop, . . . Paper mill, ... Private buildings, . . . Edison Electric Company Station, ...	2 1 1 3 1
Hyde Park, .	10′ 7″×11′ 7″ to 4′ 0″×4′ 1″,	4.527	17	Mattapan Paper Mills, . . Private building, . . .	1 2
Roxbury, . .	6′ 6″×7″, 4′ 0″, . .	1.430	–	– –	–
West Roxbury, .	9′ 3″×10′ 2″ to 12″, . .	7.600	13	Parental School, . . . Lutheran Evangelical Church, Private buildings, . . .	1 1 4
Brookline, . .	6′ 6″×7′ 0″ to 8″, . .	2.540[4]	12	Private buildings, . . .	–
Dedham, . .	4′×4′ 1″ to 3′ 9″×3′ 10″, .	2.350	7	– –	1
Hull, . . .	60″ pipe, ...	0.750	–	– –	–
Milton, . . .	11′×12′ to 8″, . . .	3.600	21	Private buildings, . . .	2
Newton, . .	4′ 2″×4′ 9″ to 1′ 3″, . .	2.911	6	Private houses, . . .	6
Quincy, . . .	11′ 3″×12′ 6″ to 24″ pipe, .	6.580	13	Metropolitan Water Works blow-off, ...	1
Waltham, . .	3′ 6″×4′0″,. . . .	0.001	1	– –	–
Watertown, . .	4′ 2″×4′ 9″ to 12″, . .	0.750[5]	5	Factories, ... Stanley Motor Carriage Co., . Knights of Pythias building,	2 1 1
		43.419	136		04

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[1] Includes .355 of a mile of sewer purchased from the city of Boston.

[2] Includes .446 of a mile of pipe and concrete sewers built for the use of the city of Boston; also .026 of a mile of sewer purchased from the town of Watertown.

[3] Includes 1.24 miles of sewer purchased from the city of Boston.

[4] Includes .158 of a mile of pipe sewer built for the use of the town of Brookline.

[5] Includes .025 of a mile of sewer purchased from the town of Watertown.

Information relating to areas, populations, local sewer connections and other data for the whole Metropolitan Sewerage District appears in the following table: —

North Metropolitan District.

Area (Square Miles).	Estimated Total Population.	Miles of Local Sewer connected.	Estimated Population contributing Sewage.	Ratio of Contributing Population to Total Population (Per Cent.).	Connections made with Metropolitan Sewers.	
					Public.	Special.
90.50	570,490	715.69	510,040	89.4	278	492
South Metropolitan District.						
100.87	393,390	592.07	262,990	66.9	136	40
Entire Metropolitan District.						
191.37	963,880	1,307.76	773,030	80.2	414	532

Of the estimated gross population of 963,880 on December 31, 1913, 773,030, representing 80.2 per cent., were on that date contributing sewage to the Metropolitan sewers, through a total length of 1,307.76 miles of local sewers owned by the individual cities and towns of the district.

These sewers are connected with the Metropolitan System by 414 public and 532 special connections. During the current year there has been an increase of 35.11 miles of local sewers connected with the Metropolitan System, and 13 public and 22 special connections have been added.

CONSTRUCTION.

NORTH METROPOLITAN SYSTEM.

At the time of the last annual report one section only (67) of the new Mystic sewer, authorized by chapter 461 of the Acts of 1912, had been let under contract. The particulars of this section and contract are given in that report.

Section 67 was completed on June 4, 1913.

During the year contracts have been let on the remaining three sections.

SECTION 68. — NORTH METROPOLITAN SYSTEM.

This section starts at the end of Section 67 in Grove Place, Winchester, and extends through Grove Place and private land of George H. Fidler, then through the Metropolitan Park land along the easterly side of the Aberjona River, crosses Bacon Street and passes through other land of the Metropolitan Park Commission to and through the Mystic Valley Parkway near its junction with Main Street, Winchester, then through other land of the Metropolitan Park Commission and private lands of Clara Joy and Esther R. Cutting and then through land of the town of Winchester to Mt. Vernon Street, a total length of 4,630 feet.

In order to facilitate travel at Bacon Street and to save some large trees on the Metropolitan Park reservation, and also the retaining wall where the sewer leaves the parkway, short tunnels were driven.

The particulars of this section and contract are as follows: —

Total length of section, 4,630 feet.
Length of tunnel, 238 feet.
Average depth of cut in open trench, 12 feet.
Diameter of concrete sewers (circular) 54 inches and 48 inches.
Name of contractor, G. M. Bryne Company.
Date of contract No. 104, June 11, 1913.
Date of completion of contract, December 31, 1913.
Division Engineer in charge of construction, Henry T. Stiff.
Assistant Engineer, A. F. F. Haskell.

In constructing this sewer along the margin of the river it became necessary to change the drainage system of the Mystic Valley Parkway. To do this the drainage was collected and carried to a point near Station 29 + 90 and there taken under the sewer in a siphon consisting of one line of 24-inch cast-iron pipe and one line of 12-inch cast-iron pipe. One other drain was taken under the sewer by means of a siphon at Station 24 + 65. To accomplish this, 570 feet of 12-inch, 15-inch, 18-inch and 24-inch double strength Akron pipe were laid and 7 catch basins were constructed. A retaining wall was constructed between Station 28 + 63 and Station 29 + 97. Pile foundation was constructed from Station 27 + 20 to Station 30 + 20, extending under the retaining wall, and from Station 32 + 14 to Station 35 + 42. Owing to the shallow cut no trench machines were used in the section except a platform derrick at the deeper portions. No excessive amount of ground water was encountered. Several excavations and refilling below grade were necessary. The masonry on this contract was completed December 23, 1913, and there yet remains a small amount of grading and surfacing.

SECTION 69. — NORTH METROPOLITAN SYSTEM.

This section begins at the end of Section 68 at the southerly side of Mt. Vernon Street and extends through private property of David N. Skillings, then through land of the town of Winchester, then through a private way, then through other land of the town of Winchester, then through private lands of John S. Lynam and Antonio Piluso and then through location of the Boston & Maine Railroad, crossing the railroad and the Aberjona River, to the beginning of Section 70. This section crosses Section 45 of the Metropolitan sewer, constructed in 1893, near Station 27 + 90.

The contract was advertised and bids were opened on November 19, 1913. The Board, however, decided to reject all bids and readvertise, dividing the section into two contracts, one extending from Station 0 to Station 23 + 0 and the other from Station 23 + 0 to Station 49 + 69. The second opening of bids occurred on December 17, and on December 31 the section was awarded to the Henry Spinach Contracting Company, the lowest bidders on both divisions of the section.

SECTION 70. — NORTH METROPOLITAN SYSTEM.

This section starts in the property of the Boston & Maine Railroad near Section 45 of the Metropolitan sewer constructed in 1893, and extends through private land of Daniel J. Daly and in Cross Street to a point in the old Mystic sewer just within the Boston & Maine Railroad location at the line between the city of Woburn and the town of Winchester. Some particulars of this section and contract are as follows: —

Total length of section, 3,535 feet.
Average depth of cut, 14 feet.
Dimensions of concrete sewer (oval), 24 inches x 36 inches.
Name of contractor, Ross & Barbaro.
Date of contract No. 103, April 9, 1913.
Division Engineer in charge of construction, Henry T. Stiff.
Assistant Engineer, A. F. F. Haskell.

At the time of writing there remain to be constructed 300 feet of sewer. In the more shallow portions of the section no excavating machine was employed, but in the deeper part a trench machine, and in one rock cut a platform derrick were used. In the progress of the work a small amount of ground water has been found, and excellent sand for concrete was obtained from the trench. The section will be completed early in the coming year.

SECTION 30. — NORTH METROPOLITAN SYSTEM.

Arrangements were entered into between the President and Fellows of Harvard College and the Metropolitan Water and Sewerage Board for the reconstruction in a new location of a part of Section 30, Cambridge, extending from Station 26 + 18 to Station 32 + 90. This portion of the section was relocated about 20 feet to the northward for the purpose of permitting the construction of new dormitories for Harvard University. Following are the particulars of the work and the contract for the same: —

Total length of new sewer constructed, 697 feet.
Average depth of cut, 13 feet.
Diameter of concrete sewer, 36 inches.
Name of contractor, William J. Barry.
Date of contract No. 102, May 1, 1913.
Date of completion of contract, August 16, 1913.
Division Engineer in charge of construction, Henry T. Stiff.
Assistant Engineer, C. A. Moore.
Total cost of reconstruction, including engineering and incidentals, $9,280.26.

The Board permitted the construction of a service tunnel for use of the dormitories across the new location at Station 1 + 68. No excessive amount of ground water was encountered. Pile foundation was constructed from Station 6 + 34.4 to Station 6 + 55.4. The entire cost of the reconstruction of this section was repaid to the Metropolitan Water and Sewerage Board by Harvard College.

SECTION 48A. — NORTH METROPOLITAN SYSTEM.

The 10-inch Metropolitan sewer constructed in Boston Avenue in 1895 for the purpose of conveying the sewage from a part of Medford across a small portion of Somerville had become inadequate to care for the sewage from this district. At the solicitation of the city of Medford, the Legislature, by chapter 377 of the Acts of 1913, authorized the construction of an additional sewer at this location. This chapter carried no appropriation, and the sewer was constructed out of construction funds already in the hands of the Board.

The particulars of this section and contract are as follows: —

Total length of section, 560 feet.
Average depth of cut, 8 feet.
Dimensions of Akron pipe sewer, 15 inches reinforced by concrete.
Name of contractor, Antony Cefalo.
Date of contract No. 105, July 1, 1913.
Date of completion of contract, August 23, 1913.
Division Engineer in charge of construction, Henry T. Stiff.
Assistant Engineer, A. F. F. Haskell.

SCREENING MACHINERY AT EAST BOSTON PUMPING STATION.

Chapter 461 of the Acts of 1912 authorized the renewal and enlargement of the screening plant at the East Boston pumping station. During the latter part of 1912 a new by-pass was constructed, also a new screen chamber. The contract for the construction of a new screen building was awarded December 26, 1912, as described in the twelfth annual report. During the present year the new screen building has been completed at a contract cost of $4,700. A contract for the construction of the screening machinery was awarded early in the year. The particulars of this contract are as follows: —

Date of contract No. 101, February 1, 1913.
Name of contractor, New England Structural Company.
Price for constructing screens and framework for supporting the machinery, $5,842.

Owing to delay of the contracting firm, partly due to difficulty in obtaining necessary material, the screens and other items under the contract were not delivered until about the middle of July. The design and construction of the electric drives for the screens and all erecting of screens and framework were done by this department. The southerly set of screens was put in operation on November 18, and has been very satisfactory. The old screens have been removed, and at the present time work is in progress in changing the old screen chamber to fit the new conditions. The remaining duplicate set of screens will be in operation early in the coming year.

MAINTENANCE.

SCOPE OF WORK AND FORCE EMPLOYED.

The maintenance of the Metropolitan Sewerage System includes the operation of 7 pumping stations, the Nut Island screen-house and 105.886 miles of Metropolitan sewers, receiving the discharge from 1,307.76 miles of town and city sewers at 414 points, together with the care and study of inverted siphons under streams and in the harbor.

The permanent maintenance force includes 167 men of whom 104 are employed on the North System and 63 on the South System. These are subdivided as follows: engineers and other employees at the pumping stations, North Metropolitan System, 64; and on maintenance, care of sewer lines, buildings and grounds, 40 men, including foremen; South Metropolitan System, 34 engineers and other employees within the pumping stations; and 29 men, including foremen, on maintenance, care of sewer lines, buildings and grounds.

The regular work of this department, in addition to the operation of the pumping stations, has consisted of routine work of cleaning and inspecting sewers and siphons, caring for tide gates, regulators and overflows, measuring flow in sewers, inspection of connections with the Metropolitan sewers, care of pumping stations and other buildings and grounds, and the maintenance of the ferry at Shirley Gut for transporting employees and supplies in connection with the operation of the Deer Island pumping station.

GRADE CROSSING AT MEDFORD STREET, SOMERVILLE, FITCHBURG DIVISION OF THE BOSTON & MAINE RAILROAD.

This work which was done by the Boston & Maine Railroad, as described in the twelfth annual report, required careful inspection to protect the Metropolitan sewer. It was largely completed in the preceding year, and during the present year it has been fully completed. The 4-foot local combined sewer in Medford Street which was connected temporarily with the Metropolitan sewer, was disconnected on January 13, 1913, and the sewage turned through its former channel. The necessary inspection was furnished from the maintenance force.

Grade Crossing at Orient Heights, Boston, Revere Beach & Lynn Railroad.

At the beginning of the year this work, which was done by the Boston, Revere Beach & Lynn Railroad, was about half completed. During the present year the work has been completed and the reinforced concrete arch over the Metropolitan sewer has been extended to Station 34 + 70, Section 8, North Metropolitan sewer. To protect the interests of the Board inspectors from the maintenance force were furnished.

Deer Island Pumping Station and Dwelling.

The 4-tenement dwelling house at Deer Island for use of employees in the station has been supplied with steam-heating apparatus during the year. Steam is supplied from the boilers of the station. This work was done by the maintenance employees.

East Boston Pumping Station.

The interior walls of the older part of the engine room of the East Boston pumping station, which were damaged during the Chelsea fire, have been covered with a cement surface placed on metal lathing secured to the brickwork, and have been finished in imitation of brickwork to correspond with the new portion of the engine room. The ironwork inside and outside of the building has been painted during the year. This work was done by the maintenance employees.

Charlestown Pumping Station.

During the year a new concrete floor has been placed in the boiler room and also one in the machine shop. The interior of the station has been cleaned and painted throughout. This work was done by the maintenance employees.

Alewife Brook Pumping Station.

During the year the stable and locker building has been newly shingled, and at the present time the interior of the pumping station is being cleaned and painted. This work was done by the maintenance employees.

SHIRLEY GUT SIPHON.

The action of the sewer gases on the masonry structure at the northerly side of Shirley Gut destroyed the Portland cement mortar, and it has been necessary to take down and reline a considerable portion of the sand catcher and head house. This work was done by the maintenance employees.

WARD STREET PUMPING STATION.

At the Ward Street pumping station the only method of delivering coal is by team. A 20-ton auto truck scale has been installed in the yard for the purpose of weighing coal as delivered at the station. The scale, which was furnished by the Fairbanks Company at a cost of $437.60, is connected with a beam inside of the station. The construction of the concrete scale pit and all other incidental work was done by the maintenance employees.

NUT ISLAND SCREEN-HOUSE.

The dwelling house at Hough's Neck, Quincy, owned by the Commonwealth and occupied by the engineer in charge of the Nut Island screen-house, has been newly shingled and otherwise repaired. This work was done by the maintenance employees.

DRAINAGE FROM TANNERIES, GELATINE AND GLUE WORKS IN WINCHESTER, WOBURN AND STONEHAM.

Five men and a foreman have been employed during a part of the year in flushing and cleaning the Metropolitan sewer through the tannery districts of Winchester, Woburn and Stoneham.

All the tanneries and glue works of the district now have settling tanks of substantial size. This method of treatment has very greatly reduced the amount of sludge material entering the Metropolitan sewers and has materially lessened the cost of maintenance of the sewers in this district.

The following table gives details of settling tanks introduced to date, showing the operations of same with the amount of sludge collected and removed: —

Table of Semi-fluid Sludge removed from Settling Basins at the Tanneries, Gelatine and Glue Works in Winchester, Woburn and Stoneham.

LOCATION OF BASIN.	Basin put in Operation.	Inside Measurement of Basin (Feet).	Number of Times cleaned during the Year 1913.	Average Quantity Semi-fluid Sludge removed during the year 1913 (Cubic Yards).	Total Quantity Semi-fluid Sludge removed during the Year 1913 (Cubic Yards).
Beggs & Cobb Company, Basin No. 1, .	Jan. 15, 1910	47.0 × 23.0	5	136.00	680.00
Beggs & Cobb Company, Basin No. 2, .	May 9, 1910	47.0 × 23.0	5	125.60	627.80
Beggs & Cobb Company, Basin No. 3, .	Oct. 19, 1911	51.0 × 25.0	3	160.40	481.20
American Hide and Leather Company, Factory E.	Aug. 1, 1910	48.3 × 23.0	1	69.80	69.88
American Hide and Leather Company, Factory D.	Nov. 15, 1910	48.0 × 23.1	5	140.00	700.00
Cottle Leather Company, ...	July 15, 1910	49.0 × 23.2	1	125.30	125.30
B. F. Kimball & Co., ...	Dec. 10, 1910	47.2 × 23.0	2½	117.50	293.82
E. Cummings Leather Company, . .	Nov. 1, 1910	45.9 × 22.6	4	77.30	309.10
W. P. Fox & Sons, ...	July 12, 1910	47.8 × 22.6	2	135.20	270.40
T. F. Boyle & Co., ...	Sept. 15, 1910	48.1 × 23.1	1	104.86	104.86
Champion Tanning Company, . . .	Jan. 9, 1911	46.8 × 22.9	5½	97.70	537.32
Stoneham Tanning Company, . . .	May 1, 1911	43.8 × 19.5	26 1	6.00 51.00	156.00 51.00
American Glue Company, . . .	Oct. 1, 1910	47.1 × 23.0	3	136.40	409.08
Winchester Manufacturing Company, .	1902	35.5 × 24.7 67.2 × 12.0	5	61.10	305.78
Total, ...	-	-	-	-	5,016.68

NORTH METROPOLITAN SEWERAGE SYSTEM.

Table showing Cities and Towns delivering Sewage in this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1913.]

CITIES AND TOWNS.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.[1]	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Deer Island), .	0.70	Separate, . . .	-	-	1,220[2]	1,220[2]	-	-	100.0	-
Winthrop, . . .	31.69	Separate, . . .	2,694	4.25	11,450	11,630	1.37	1.61	98.5	85.1
Boston (East Boston), .	32.25	Separate and combined,	4,901	12.60	61,755	64,660	1.14	2.18	95.5	52.3
Chelsea, ...	30.39	Separate and combined,	3,802	9.20	34,980	36,360	1.13	2.24	96.2	50.4
Everett, ...	46.60	Separate and combined,	4,725	6.85	32,365	37,900	1.97	3.34	85.4	59.0
Malden, ...	61.36	Separate, . . .	6,294	6.40	40,280	48,420	3.00	5.07	83.2	59.2
Melrose, ...	37.56	Separate, . . .	3,022	4.60	13,900	16,780	1.81	3.73	82.8	48.5
Boston (Charlestown), .	21.16	Separate and combined,	5,359	7.85	42,070	42,500	0.67	1.27	99.0	52.8
Cambridge, . . .	148.70	Separate and combined,	16,069	6.75	108,465	110,100	5.02	6.11	98.5	82.2
Somerville, . . .	99.10	Separate and combined,	15,075	5.45	82,160	83,670	3.40	3.96	98.2	85.9
Medford, . . .	58.83	Separate, . . .	4,861	5.25	25,520	26,040	3.03	8.35	98.0	36.3
Winchester, . . .	27.24	Separate, . . .	1,542	5.40	8,325	10,150	1.34	5.95	82.0	22.5
Woburn, . . .	14.35[3]	Separate, . . .	1,129	5.80	6,550	16,150	0.96	12.71	40.6	7.6
Stoneham, . . .	13.14	Separate, . . .	865	5.10	4,410	7,950	0.69	5.50	55.5	12.5
Arlington, . . .	26.49	Separate, . . .	1,629	5.90	9,610	12,760	1.80	5.20	75.3	34.6
Belmont, . . .	16.83	Separate, . . .	850	6.30	5,850[4]	6,440	1.17	4.66	90.8	25.1
Wakefield, . . .	13.21	Separate, . . .	684	5.60	3,830	12,260	0.53	7.65	31.2	6.9
Lexington,[5] . . .	-	- -	-	-	-	4,410	-	5.11	-	-
Revere, ...	36.09	Separate, . . .	2,932	5.90	17,300	21,090	1.88	5.86	82.0	32.1
Totals, . . .	715.69	- -	76,433	6.70	510,040	570,490	30.91	90.50	89.4	34.2

[1] Estimated from assessors' statement of the number of houses in each city or town on April 1, 1913, and the population from census of 1910.

[2] Estimated by Supt. James H. Cronin of the institution on Deer Island.

[3] Exclusive of Mystic valley sewer and tanneries.

[4] Including 2 connections with McLean Hospital, having an estimated population of 495.

[5] Lexington not connected.

SOUTH METROPOLITAN SEWERAGE SYSTEM.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1913.]

CITIES AND TOWNS.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.[1]	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Back Bay),	25.08	Separate and combined,	1,690	17.0	28,730	29,380	1.14	1.48	97.8	77.0
Boston (Brighton),	58.54	Separate and combined,	3,317	6.4	21,230	30,975	3.17	3.74	68.5	84.8
Brookline,	68.70	Separate and combined,	4,193	7.1	29,770	30,800	3.53	6.81	96.7	51.8
Newton,	118.00	Separate,	6,505	6.0	39,000	43,120	7.42	16.88	90.4	44.0
Watertown,	39.66	Separate,	2,153	5.1	10,980	14,250	2.12	4.04	77.1	52.5
Waltham,	45.98	Separate,	3,651	7.6	27,930	30,070	2.28	13.03	92.9	17.5
Boston (Dorchester),	53.14	Separate and combined,	5,244	7.9	41,430	69,400	2.43	4.89	59.7	49.7
Milton,	12.57	Separate and combined,	678	5.3	3,595	8,550	0.76	12.69	42.0	6.0
Boston (Hyde Park),	31.25	Separate,	2,053	7.0	14,370	16,790	1.48	4.57	85.6	32.4
Dedham,	16.45	Separate,	711	4.9	3,485	9,730[2]	0.81	9.40	35.8	8.6
Boston (Roxbury),	-	-	-	-	-	43,340	-	1.88	-	-
Boston (West Roxbury),	52.11	Separate and combined,	3,831	5.8	20,930[3]	31,015	2.44	8.92	67.5	27.4
Quincy,	69.35	Separate,	4,390	4.9	21,510	35,970	3.06	12.56	59.8	24.4
Totals,	590.83	-	37,916	6.9	262,960	393,390	30.84	100.87	66.8	30.6

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[1] Estimated from assessors' statement of the number of houses in each city or town on April 1, 1913, and the population from census of 1910.

[2] Part of town not included in Metropolitan Sewerage District.

[3] Including connection with institution at Austin Farm, having an estimated population of 1,613.

WHOLE METROPOLITAN SYSTEM.

Table showing Areas delivering Sewage to the Entire System, inclusive of Added High-level Area; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1913.]

SYSTEM.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
North Metropolitan, .	715.69	Separate and combined,	76,433	6.7	510,040	570,490	30.91	90.50	89.4	34.2
South Metropolitan, .	592.07	Separate and combined,	37,916	6.9	262,990	393,390	30.89	100.87	66.9	30.6
Totals, ...	1,307.76	- -	114,349	6.8	773,030	963,880	61.80	191.37	80.2	32.3

PUMPING STATIONS.

Capacity and Results.

It will be noticed that the pumping expense per million foot-gallons in the three large stations of the North System is slightly in excess of last year. This is due principally to the increase in the engineers' salaries in these stations, which amounted to approximately 12 per cent. extending over most of the year. The remaining stations show a slight decrease in the cost per million foot-gallons.

The following tables summarize the pumping records for the year for the Metropolitan sewerage stations: —

Average Daily Volume of Sewage lifted at Each of the Six Principal Metropolitan Pumping Stations and the Quincy Sewage Lifting Station during the Year, as compared with the Corresponding Volumes for the Previous Year.

PUMPING STATION.	AVERAGE DAILY PUMPAGE.			
	Jan. 1, 1912, to Dec. 31, 1912.	Jan. 1, 1913, to Dec. 31, 1913.	Increase during the Year.	
	Gallons.	Gallons.	Gallons.	Per Cent.
Deer Island,	55,700,000	56,600,000	900,000	1.6
East Boston,	53,700,000	54,600,000	900,000	1.7
Charlestown,	34,600,000	33,700,000	900,000[1]	2.6[1]
Alewife Brook,	3,446,000	3,614,000	168,000	4.9
Quincy,	3,958,000	4,154,000	196,000	5.0
Ward Street (actual gallons pumped),	26,258,000	27,056,000	798,000	3.0
Quincy sewage lifting station,	48,000	68,700	20,700	43.1

[1] Decrease.

North Metropolitan System.

Deer Island Pumping Station.

At this station are four submerged centrifugal pumps with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons, with 19-foot lift.
Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.
Average duty for the year: 55,300,000 foot-pounds.
Average quantity raised each day: 56,600,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 3 oilers, 3 screenmen, 1 relief screenman and 1 laborer.
Coal used: New River, costing from $3.91 to $4.62 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Deer Island Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1913.						
January,	1,842,000,000	59,400,000	45,100,000	101,300,000	10.79	53,500,000
February,	1,475,800,000	52,700,000	41,900,000	87,700,000	10.65	49,800,000
March,	2,001,400,000	64,600,000	47,800,000	112,300,000	10.51	49,600,000
April,	2,323,600,000	77,500,000	59,000,000	123,700,000	11.24	59,000,000
May,	1,812,900,000	58,500,000	44,600,000	87,900,000	10.59	58,300,000
June,	1,562,200,000	52,100,000	43,400,000	60,100,000	10.27	53,500,000
July,	1,432,700,000	46,200,000	33,800,000	64,300,000	10.54	56,000,000
August,	1,418,000,000	45,700,000	34,800,000	58,500,000	10.42	54,800,000
September,	1,370,600,000	45,700,000	34,600,000	65,300,000	10.63	58,200,000
October,	1,946,900,000	62,800,000	46,500,000	103,900,000	11.47	59,900,000
November,	1,621,700,000	54,100,000	44,600,000	95,400,000	11.68	57,800,000
December,	1,846,100,000	59,600,000	45,500,000	112,800,000	11.06	52,800,000
Total,	20,654,200,000	-	-	-	-	-
Average,	-	56,600,000	43,500,000	89,400,000	10.82	55,300,000

Average Cost per Million Foot-gallons for Pumping at the Deer Island Station.

Volume (20,654.2 Million Gallons) × Lift (10.82 Feet) = 223,478.4 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	$14,832 40	$0.06637
Coal,	9,689 25	.04336
Oil,	344.79	.00154
Waste,	167 96	.00075
Water,	1,537 20	.00688
Packing,	169 48	.00076
Miscellaneous supplies and renewals,	1,814 01	.00812
Totals,	$28,555 09	$0.12778
Labor at screens,	-	.01366

East Boston Pumping Station.

At this station are four submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons with 19-foot lift.

Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 65,400,000 foot-pounds.

Average quantity raised each day: 54,600,000 gallons.

Force employed: 4 engineers, 2 relief engineers, 4 firemen, 1 relief fireman, 3 oilers, 3 screenmen, 1 relief screenman, 3 helpers and 1 laborer.

Coal used: New River, costing from $3.92 to $4.51 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs Coal).
1913.						
January, ...	1,780,300,000	57,400,000	43,100,000	99,300,000	14.94	60,300,000
February, . . .	1,419,800,000	50,700,000	39,900,000	85,700,000	14.86	55,400,000
March, ...	1,939,400,000	62,600,000	45,800,000	110,300,000	15.36	65,900,000
April, ...	2,263,600,000	75,500,000	57,000,000	121,700,000	15.37	69,900,000
May, ...	1,750,900,000	56,500,000	42,600,000	85,900,000	15.18	76,500,000
June, ...	1,502,200,000	50,100,000	41,400,000	58,100,000	14.92	70,400,000
July, ...	1,370,700,000	44,200,000	31,800,000	62,300,000	14.61	62,200,000
August, ...	1,356,000,000	43,700,000	32,800,000	56,500,000	14.95	71,300,000
September, . . .	1,310,600,000	43,700,000	32,600,000	63,300,000	15.21	66,700,000
October, ...	1,884,900,000	60,800,000	44,500,000	101,900,000	18.56	52,000,000
November, . . .	1,561,700,000	52,100,000	42,600,000	93,400,000	15.86	67,800,000
December, . . .	1,784,100,000	57,600,000	43,500,000	110,800,000	14.98	66,900,000
Total, . . .	19,924,200,000	-	-	-	-	-
Average, . . .	-	54,600,000	41,500,000	87,400,000	15.40	65,400,000

Average Cost per Million Foot-gallons for Pumping at the East Boston Station.

Volume (19,924.2 Million Gallons) × Lift (15.40 Feet) = 306,832.7 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, ...	$20,481 78	$0.06676
Coal, ...	11,437 98	.03728
Oil, ...	416 69	.00136
Waste, ...	116 96	.00038
Water, ...	2,476 56	.00807
Packing, ...	87 02	.00028
Miscellaneous supplies and renewals, ...	2,622 41	.00855
Totals, ...	$37,639 40	$0.12268
Labor at screens, ...	-	.01001

Charlestown Pumping Station.

At this station are three submerged centrifugal pumps, two of them having impellers or wheels, 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 60,000,000 gallons with 8-foot lift.
Contract capacity of 2 pumps: 22,000,000 gallons each, with 11 foot lift.
Average duty for the year: 45,900,000 foot-pounds.
Average quantity raised each day: 33,700,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 3 oilers, 3 screenmen and 1 relief screenman.
Coal used: New River and Pocahontas, costing from $3.93 to $4.57 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1913.						
January,	1,086,700,000	35,100,000	28,400,000	50,400,000	8.34	46,200,000
February,	965,900,000	34,500,000	27,300,000	55,800,000	8.22	46,000,000
March,	1,162,400,000	37,500,000	23,900,000	64,800,000	8.33	60,100,000
April,	1,219,400,000	40,600,000	30,700,000	65,500,000	8.45	62,700,000
May,	1,036,000,000	34,500,000	27,100,000	52,100,000	7.91	46,500,000
June,	1,105,700,000	36,900,000	30,800,000	48,400,000	8.63	61,300,000
July,	932,100,000	30,100,000	23,700,000	39,900,000	7.99	43,900,000
August,	1,089,700,000	35,200,000	25,000,000	43,600,000	8.19	51,400,000
September,	879,700,000	29,300,000	21,600,000	44,600,000	7.68	41,300,000
October,	1,030,400,000	33,200,000	15,000,000	47,900,000	8.27	42,000,000
November,	857,400,000	28,600,000	20,700,000	49,500,000	8.05	36,900,000
December,	911,500,000	29,400,000	21,500,000	55,200,000	7.81	32,200,000
Total,	12,270,000,000	-	-	-		
Average,	-	33,700,000	24,900,000	51,500,000	8.16	45,900,000

Average Cost per Million Foot-gallons for Pumping at the Charlestown Station.

Volume (12,276.9 Million Gallons) × Lift (8.16 Feet) = 100,179.5 Million Foot-gallons.

Items.	Cost.	Cost per Million Foot-gallons.
Labor,	$13,662 66	$0.13638
Coal,	4,511 20	.04504
Oil,	137 92	.00138
Waste,	92 12	.00092
Water,	657 60	.00656
Packing,	40 77	.00041
Miscellaneous supplies and renewals,	955 04	.00953
Totals,	$20,057 31	$0.20022
Labor at screens,	-	.03060

Alewife Brook Pumping Station.

The plant at this station consists of the original installation of small commercial pumps and engines, *i.e.*, two 9-inch Andrews vertical centrifugal pumps, with direct-connected compound marine engines, together with the recent addition. The latter consists of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the two original pumps: 4,500,000 gallons each, with 13-foot lift.
Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.
Average duty for the year: 18,100,000 foot-pounds.
Average quantity raised each day: 3,614,000 gallons.
Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.
Coal used: New River, costing from $4.48 to $5.06 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1913.						
January,	141,136,000	4,553,000	3,526,000	6,813,000	12.70	19,400,000
February,	105,742,000	3,777,000	3,028,000	6,012,000	12.24	17,200,000
March,	158,996,000	5,129,000	3,478,000	7,934,000	12.53	20,900,000
April,	181,698,000	6,057,000	4,738,000	7,698,000	12.70	25,800,000
May,	126,111,000	4,068,000	3,028,000	5,818,000	12.56	19,500,000
June,	94,797,000	3,160,000	2,414,000	4,085,000	12.92	18,100,000
July,	74,878,000	2,415,000	1,952,000	3,430,000	13.01	16,200,000
August,	69,178,000	2,232,000	1,784,000	3,179,000	12.96	15,800,000
September,	65,298,000	2,177,000	1,784,000	3,028,000	12.98	14,500,000
October,	100,837,000	3,253,000	2,120,000	6,012,000	12.91	17,400,000
November,	89,123,000	2,971,000	2,456,000	5,170,000	13.01	16,000,000
December,	110,967,000	3,580,000	2,928,000	5,947,000	12.88	16,800,000
Total,	1,318,761,000	-	-	-	-	-
Average,	-	3,614,000	2,770,000	5,427,000	12.78	18,100,000

Average Cost per Million Foot-gallons for Pumping at the Alewife Brook Station.

Volume (1,318.761 Million Gallons) × Lift (12.78 Feet) = 16,853.8 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	$6,495 27	$0.38539
Coal,	1,732 00	.10277
Oil,	134 93	.00801
Waste,	91 88	.00545
Water,	207 72	.01232
Packing,	21 86	.00130
Miscellaneous supplies and renewals,	306 96	.01821
Totals,	$8,990 62	$0.53345
Labor at screens, oiling and miscellaneous services,	-	.11110

SOUTH METROPOLITAN SYSTEM.

Ward Street Pumping Station.

At this station are two vertical, triple-expansion pumping engines, of the Allis-Chalmers type, operating reciprocating pumps, the plungers of which are 48 inches in diameter with a 60-inch stroke.

Contract capacity of 2 pumps: 50,000,000 gallons each, with 45-foot lift.
Average duty for the year: 84,217,000 foot-pounds.
Average quantity raised each day: 27,056,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 4 oilers, 4 assistant engineers, 1 machinist and 1 laborer.
Coal used: New River, costing from $4.23 to $5.13 per gross ton.
Material intercepted at screens during the year, 1,170 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Ward Street Pumping Station of the South Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1913.						
January,	867,261,000	28,008,000	24,017,000	35,562,000	40.63	79,000,000
February,	720,994,000	25,750,000	22,746,000	41,288,000	40.76	82,500,000
March,	1,023,342,000	33,013,000	24,261,000	58,214,000	41.64	88,700,000
April,	1,243,097,000	41,432,000	31,250,000	50,082,000	42.25	100,500,000
May,	914,397,000	29,496,000	24,513,000	38,030,000	41.46	92,400,000
June,	729,936,000	24,330,000	19,423,000	29,801,000	40.77	84,600,000
July,	655,540,000	21,113,000	17,429,000	28,263,000	40.47	81,700,000
August,	659,927,000	21,352,000	18,150,000	29,879,000	41.36	84,600,000
September,	620,930,000	20,670,000	17,889,000	30,059,000	40.59	70,700,000
October,	797,624,000	25,730,000	19,651,000	44,319,000	41.33	76,200,000
November,	769,725,000	25,657,000	21,773,000	40,474,000	41.35	80,600,000
December,	871,916,000	28,126,000	23,021,000	41,720,000	41.50	89,100,000
Total,	9,874,689,000	-	-	-	-	-
Average,	-	27,056,000	22,010,000	39,590,000	41.18	84,217,000

Records from plunger displacement.

Average Cost per Million Foot-gallons for Pumping at the Ward Street Station.

Volume (9,874.7 Million Gallons) × Lift (41.18 Feet) = 406,640 Million Foot-gallons.

Items.	Cost.	Cost per Million Foot-gallons.
Labor,	$16,906 67	$0.04158
Coal,	8,607 15	.02117
Oil,	206 72	.00051
Waste,	34 11	.00008
Water,	1,389 60	.00342
Packing,	185 67	.00046
Miscellaneous supplies and renewals,	2,227 50	.00548
Totals,	$29,557 42	$0.07270
Labor at screens,	–	.00996

Quincy Pumping Station.

At this station are two compound condensing Deane pumping engines and one Lawrence centrifugal pump driven by a Sturtevant compound condensing engine.

Contract capacity of 3 pumps: Deane, 3,000,000 gallons; Deane, 5,000,000 gallons; Lawrence centrifugal, 10,000,000 gallons.
Average duty for the year: 31,325,000 foot-pounds.
Average quantity raised each day: 4,154,000 gallons.
Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.
Coal used: New River, costing from $4.45 to $4.65 per gross ton.
Materials intercepted at screen during the year, 199 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Ft.-lbs. per 100 lbs. Coal).
[illegible]						
January,	147,278,000	4,751,000	4,200,000	5,547,000	21.72	31,000,000
February,	113,031,000	4,037,000	3,395,000	5,128,000	21.18	29,000,000
March,	176,469,000	5,692,000	4,512,000	9,650,000	22.35	34,000,000
April,	210,472,000	7,016,000	5,254,000	13,915,000	23.01	35,100,000
May,	143,024,000	4,614,000	4,085,000	5,600,000	21.77	27,700,000
June,	114,636,000	3,821,000	3,124,000	4,985,000	21.92	30,600,000
July,	100,312,000	3,236,000	2,882,000	3,601,000	21.06	31,700,000
August,	91,187,000	2,941,000	2,507,000	3,226,000	21.10	32,000,000
September,	82,941,000	2,765,000	2,365,000	3,078,000	21.06	29,700,000
October,	106,598,000	3,439,000	2,721,000	4,387,000	21.08	31,100,000
November,	107,917,000	3,597,000	3,055,000	3,959,000	20.99	32,300,000
December,	122,391,000	3,948,000	3,527,000	4,944,000	21.04	31,100,000
Total,	1,516,256,000	-	-	-	-	-
Average,	-	4,154,000	3,469,000	5,662,000	21.39	31,325,000

Average Cost per Million Foot-gallons for Pumping at the Quincy Station.

Volume (1,516.2 Million Gallons) × Lift (21.39 Feet) = 33,198 Million Foot-gallons.

Items.	Cost.	Cost per Million Foot-gallons.
Labor,	$6,400 00	$0.19283
Coal,	1,813 18	.05463
Oil,	39 69	.00119
Waste,	35 22	.00106
Water,	230 89	.00696
Packing,	41 59	.00125
Miscellaneous supplies and renewals,	478 02	.01440
Totals,	$9,038 59	$0.27232
Labor at screens, oiling and miscellaneous services,	-	.04686

Nut Island Screen-house.

The plant at this house includes two sets of screens in duplicate actuated by small reversing engines of the Fitchburg type. Two vertical Deane boilers, 80 horse-power each, operate the engines, provide heat and light for the house, burn materials intercepted at the screens, and furnish power for the Quincy sewage lifting station.

Average daily quantity of sewage passing screens, 53,020,000 gallons.
Total materials intercepted at screens, 1,148.76 cubic yards.
Materials intercepted per million gallons of sewage discharged, 1.60 cubic feet.
Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.
Coal used: New River, costing from $4.04 to $4.60 per gross ton.

Quincy Sewage Lifting Station.

At this station are two 6-inch submerged Lawrence centrifugal pumps with vertical shafts actuated by two Sturtevant direct-current motors.

The labor and electric energy for this station are supplied from the Nut Island screen-house and as used at present it does not materially increase the amount of coal used at the latter station. The effluent is largely ground water.

Average daily amount pumped, 68,700 gallons.
Average lift, 15.8 feet.

Coal delivered in the Bins of the Sewerage Works Pumping Stations during the Year.

	Gross Tons, Bituminous Coal.							
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen-house.	Price per Gross Ton.[1]
Metropolitan Coal Company, .	137.708	-	-	-	-	-	-	$3 91
Metropolitan Coal Company, .	354.925	-	-	-	-	-	-	3 98
Metropolitan Coal Company, .	1,294.000	-	-	-	-	-	-	4 62
Metropolitan Coal Company, .	-	284.303	-	-	-	-	-	3 92
Metropolitan Coal Company, .	-	595.300	-	-	-	-	-	3 94
Metropolitan Coal Company, .	-	395.170	-	-	-	-	-	3 97
Metropolitan Coal Company, .	-	395.000	-	-	-	-	-	3 98
Metropolitan Coal Company, .	-	154.000	-	-	-	-	-	4 00
Metropolitan Coal Company, .	-	295.000	-	-	-	-	-	4 28
Metropolitan Coal Company, .	-	237.000	-	-	-	-	-	4 36
Metropolitan Coal Company, .	-	240.000	-	-	-	-	-	4 40
Metropolitan Coal Company, .	-	361.000	-	-	-	-	-	4 45
Metropolitan Coal Company, .	-	230.000	-	-	-	-	-	4 51
Metropolitan Coal Company, .	-	-	280.000	-	-	-	-	3 93
Metropolitan Coal Company, .	-	-	225.000	-	-	-	-	3 99
Metropolitan Coal Company, .	-	-	266.000	-	-	-	-	4 32
Metropolitan Coal Company, .	-	-	239.372	-	-	-	-	4 57
Locke Coal Company, . .	-	-	-	15.167	-	-	-	4 47
Locke Coal Company, . .	-	-	-	57.960	-	-	-	4 48
Locke Coal Company, . .	-	-	-	37.960	-	-	-	4 49
Locke Coal Company, . .	-	-	-	65.240	-	-	-	4 54
Locke Coal Company, . .	-	-	-	46.230	-	-	-	4 56
Locke Coal Company, . .	-	-	-	36.470	-	-	-	4 58
Locke Coal Company, . .	-	-	-	45.285	-	-	-	4 60
Locke Coal Company, . .	-	-	-	23.200	-	-	-	4 96
Locke Coal Company, . .	-	-	-	45.300	-	-	-	5 01
Locke Coal Company, . .	-	-	-	73.776	-	-	-	5 06
Metropolitan Coal Company, .	-	-	-	-	348.926	-	-	4 23
Metropolitan Coal Company, .	-	-	-	-	277.360	-	-	4 25
Metropolitan Coal Company, .	-	-	-	-	75.767	-	-	4 26
Metropolitan Coal Company, .	-	-	-	-	374.300	-	-	4 33

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[1] Include adjustments for quality.

Coal delivered in the Bins of the Sewerage Works Pumping Stations during the Year — Concluded.

	GROSS TONS, BITUMINOUS COAL.							
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen-house.	Price per Gross Ton.[1]
Metropolitan Coal Company, .	-	-	-	-	155.910	-	-	$4 37
Metropolitan Coal Company, .	-	-	-	-	174.990	-	-	4 98
Metropolitan Coal Company, .	-	-	-	-	277.848	-	-	5 06
Metropolitan Coal Company, .	-	-	-	-	76.013	-	-	5 07
Metropolitan Coal Company, .	-	-	-	-	222.071	-	-	5 09
Metropolitan Coal Company, .	-	-	-	-	131.240	-	-	5 13
City Fuel Company, . . .	-	-	-	-	-	62.800	-	4 45
City Fuel Company, . . .	-	-	-	-	-	27.401	-	4 48
City Fuel Company, . . .	-	-	-	-	-	61.180	-	4 57
City Fuel Company, . . .	-	-	-	-	-	65.174	-	4 61
City Fuel Company, . . .	-	-	-	-	-	134.379	-	4 65.
Frost Coal Company, . . .	-	-	-	-	-	50.000	-	5 04
Frost Coal Company, . . .	-	-	-	-	-	9.250	-	5 10
Metropolitan Coal Company, .	-	-	-	-	-	-	200	4 04
Metropolitan Coal Company, .	-	-	-	-	-	-	194	4 60
Metropolitan Coal Company, .	-	-	-	-	-	-	200	4 70
Total gross tons, . . .	2,964.520	3,098,763	1,013.372	448.628	2,114.425	410.184	594	-
Average price per gross ton, .	$4 21	$4 146	$4 196	$4 69	$4 609	$4 647	$4 445	-

[1] Include adjustments for quality.

METROPOLITAN SEWERAGE OUTFALLS.

The Deer Island outfall has been in continuous operation since May, 1895.

The 60-inch outfall pipes on the South Metropolitan System have been in operation since October, 1904.

These outfalls are in good condition and free from deposit. During the year the average flow through the North Metropolitan outfall at Deer Island has been 56,600,000 gallons of sewage per 24 hours, with a maximum rate of 148,700,000 gallons on December 26. The amount of sewage discharged in the North Metropolitan

District averaged 111 gallons per day for each person, taking the estimated population of the district contributing sewage. If the sewers in this district were restricted only to the admission of sewage proper, and all local sewers were separate sewers, this per capita amount would be considerably decreased.

In the South Metropolitan District an average of 53,020,000 gallons of sewage has passed daily through the screens at the Nut Island screen-house, and has been discharged from the outfalls into the outer harbor. The maximum discharge per day, which occurred during a heavy storm on April 13, was 152,000,000 gallons. The discharge of sewage through these outfalls represents the amount of sewage contributed in the South Metropolitan System, which was at the rate of 202 gallons per day per person of the estimated number contributing sewage in the District.

The daily discharge of sewage per capita is considerably larger in the South Metropolitan District than it is in the North Metropolitan District, because, owing to the large size of the High-level sewer, more storm water is admitted at periods of heavy rainfall.

Material Intercepted at the Screens.

The material intercepted at the screens at the North Metropolitan Sewerage stations, consisting of rags, paper and other floating materials, has during the year amounted to 4,056 cubic yards. This is equivalent to 5.3 cubic feet for each million gallons of sewage pumped at Deer Island.

The material intercepted at the screens at the South Metropolitan Sewerage stations has amounted to 2,517.27 cubic yards, equal to 3.51 cubic feet per million gallons of sewage delivered at the outfall works at Nut Island.

Studies of the sewage flows indicate that the Metropolitan sewers and siphons are free from deposit.

FREDERICK D. SMITH,
Engineer of Sewerage Works.

BOSTON, January 1, 1914.

APPENDIX.

APPENDIX No. 1.

CONTRACTS MADE AND PENDING

[The details of contracts made before 1913

	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	312[2]	40-million-gallon pumping engine.	4	$105,700 00	$99,769 00[1]	Holly Mfg. Co., Buffalo, N. Y.
2	346	2 3-million-gallon pumping engines for Southern Extra High Service pumping station.	Engine No. 1, 5.	7,886 00	7,525 00[1]	Laidlaw-Dunn-Gordon Co., Cincinnati, O.
			Engine No. 2, 7.	8,825 00[1],[3]	8,738 00	
3	347[2]	Southern Extra High Service pumping station.	10	21,148 00	19,984 00[1]	A. Varnerin Company, Boston.
4	350[2]	Furnishing and placing about 1,200 cubic yards of loam at Southern Extra High Service pumping station.	1	-	$1.30[1] per cu. yd.	T. H. Corrigan, Boston.
5	351[2]	400 tons cast-iron water pipe; 220 tons 24-inch, 80 tons 30-inch, 100 tons 36-inch pipe; and 50 tons special castings.	4	11,965 00	$11,950 00[1]	Florence Iron Works, Philadelphia, Pa.
6	25-M[2]	Electric motor and centrifugal pump for Clinton sewerage pumping station.	6	965 00[1],[3]	786 00	Power Equipment Co., Boston.
7	26-M[2]	450 tons B. C. C. Miller vein coal for Arlington pumping station.	2	$4.30 per ton.	$4.24[1] per ton.	Bader Coal Co., Boston.
8	27-M[2]	1,000 tons Georges Creek Cumberland coal for Spot Pond pumping station.	2	$5.05 per ton.	$4.80[1] per ton.	Locke Coal Co., Malden.
9	28-M[2]	7,000 tons Sonman coal for Chestnut Hill pumping stations.	8	$3.80 per ton.	$3.79[1] per ton.	Gorman-Leonard Coal Co., Worcester.
10	31-M	450 tons C. C. B. New River coal for Arlington pumping station.	1	-	$4.38[1] per ton.	Bader Coal Co., Boston.

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[1] Contract based upon this bid.

[2] Contract completed.

APPENDIX No. 1.

DURING THE YEAR 1913.

have been given in previous reports.]

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1913.	10. Value of Work done Dec. 31, 1913.	
Sept. 21, 1909	Jan. 29, 1913	- -	$99,769 00	1
Sept. 18, 1911	Jan. 16, 1913	- -	18,585 20	2
Mar. 28, 1912	Nov. 10, 1913	- -	20,962 13	3
Dec. 30, 1912	July 24, 1913	- -	2,810 60	4
Mar. 5, 1913	July 24, 1913	For pipe, $23 per ton of 2,000 pounds; for special castings, $55 per ton of 2,000 pounds.	12,115 34	5
May 31, 1912	Feb. 26, 1913	- -	965 00	6
June 3, 1912	May 3, 1913	- -	1,950 54	7
June 5, 1912	May 29, 1913	- -	4,765 88	8
June 3, 1912	Aug. 7, 1913	- -	26,651 20	9
June 25, 1913	-	$4.38 per ton of 2,240 pounds delivered on cars at the Arlington station.	1,201 10	10

[3] Efficiency considered, this was lowest bid.

CONTRACTS MADE AND PENDING

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
11	32-M	750 tons Georges Creek Cumberland or New River coal for Spot Pond pumping station.	1	-	$5.30[1] per ton.	Locke Coal Co., Malden.
12	33-M	5,000 tons Beaver Run coal for Chestnut Hill pumping stations; 300 tons Beaver Run coal for Hyde Park pumping station, and 85 tons Beaver Run coal for Pegan pumping station.	Chestnut Hill stations, 3. Hyde Park station, 4. Pegan station, 3.	$4.02[1] per ton. $4.17[1] per ton. $4.24[1] per ton.	$3.97 per ton. $4.12 per ton. $4.19 per ton.	Gorman-Leonard Coal Co., Worcester.
13	Special[2] Order.	Plumbing in lavatory and locker room at Chestnut Hill pumping station.	3	$375 00	$340 00[1]	H. W. Orr Company, Newtonville.
14	Special[2] Order.	Electric light installation at Hyde Park pumping station.	4	480 00	457 00[1]	James Wilkinson Company, Boston.
15	Special[2] Order.	Furnishing and erecting ferrolithic plate, plastering and concrete floor of lavatory and locker room at Chestnut Hill pumping station.	3	693 00	540 00[1]	Robert Gallagher Company, Boston.
16	Special[2] Order.	2,250 feet 9-inch by 9-inch J. C. Edwards red tile for engine room floor at Hyde Park pumping station.	3	416 25[4]	416 25[1]	L. L. Rinaldi & Co., Boston.
17	Special[2] Order.	1 Fitzhenry-Guptill Co. standard "A" power sprayer; 1 Fitzhenry-Guptill Co. power truck sprayer, less commercial body.	–[5]	–[5]	–[5]	Fitzhenry-Guptill Co., Boston.
18	Special[2] Order.	Cast-iron floor plates for Hyde Park pumping station.	5	275 00	220 00[1]	Becker Milling Machine Co., Boston.
19	Special[2] Order.	Laying tile floor in engine room of Hyde Park pumping station.	5	280 00	220 00[1]	Galassi Mosaic & Tile Co., Boston.
20	Special[2] Order.	Painting and varnishing at the Chestnut Hill pumping stations.	6	600 00	568 00[1]	Geo. H. Walsh, Boston.
21	Special[2] Order.	Artificial stone walks at Hyde Park pumping station.	4	476 00	475 00[1]	Warren Brothers Co., Boston.
22	Special[2] Order.	Painting and varnishing at Spot Pond pumping station.	4	367 00	300 00[1]	C. P. Hicks Co., Malden.

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[1] Contract based upon this bid.

[2] Contract completed.

DURING THE YEAR 1913 — *Continued.*

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1913.	10. Value of Work done Dec. 31, 1913.	
June 25, 1913	-	$5.30 per ton of 2,240 pounds delivered in bins at the Spot Pond station.	$2,203 49	11
July 1, 1913	-	$4.02 per ton of 2,240 pounds delivered on cars at the Chestnut Hill stations; $4.17 per ton of 2,240 pounds delivered on cars at the Hyde Park station, and $4.24 per ton of 2,240 pounds delivered at the Natick station on the Boston & Albany Railroad.	8,889 14	12
Oct. 9, 1912	Apr. 1, 1913	- -	355 25	13
Dec. 27, 1912	Feb. 20, 1913	- -	457 00	14
Oct. 9, 1912	Feb. 12, 1913	- -	540 00	15
Jan. 24, 1913	Mar. 12, 1913	For whole work, $416.25, ...	416 25	16
Feb. 27, 1913	May 27, 1913	Standard "A" power sprayer, $1,187.15; power truck sprayer less commercial body, $4,387.	5,574 15	17
Mar. 14, 1913	May 28, 1913	For whole work, $220, ...	220 00	18
Mar. 18, 1913	Apr. 5, 1913	For whole work, $220, ...	220 00	19
Apr. 22, 1913	June 2, 1913	For whole work, $568, ...	645 30	20
Apr. 24, 1913	May 31, 1913	For whole work, $475, ...	475 00	21
May 8, 1913	June 19, 1913	For whole work, $300, ...	300 00	22

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[4] Longer time required for delivery.

[5] Competitive bids not received.

CONTRACTS MADE AND PENDING

1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
23 Special[2] Order.	4,263 sq. ft. No. 24-inch "Self-sentering" sheets for reinforcing concrete floor of engine room at Chestnut Hill pumping station.	3	$273 00	$255 78[1]	Penn Metal Co., Boston.
24 Special[2] Order.	7,202 pieces 9-inch by 9-inch quarry tile for floors at Chestnut Hill pumping station.	5	781 14	737 82[1]	L. L. Rinaldi Co., Boston.
25 Special[2] Order.	Laying tile floors at Chestnut Hill pumping station.	5	419 00	400 00[1]	Samuel H. Shaw Co., Boston.
26 Special[2] Order.	400 stone land bounds, .	6	$1 35 each.	$1 10[1] each.	Henry Godbeer, Fitchburg.
27 Special Order.	Pelton water wheel for machine shop at Chestnut Hill pumping station.	–[5]	–[5]	–[5]	Pelton Water Wheel Co., New York.

[1] Contract based upon this bid. [2] Contract completed.

DURING THE YEAR 1913 — *Continued.*

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1913.	10. Value of Work done Dec. 31, 1913.	
July 21, 1913	Aug. 2, 1913	For whole work, $255.78, ...	$255 78	23
July 24, 1913	Oct. 1, 1913	For whole work, $737.82, ...	737 82	24
Oct. 8, 1913	Nov. 20, 1913	For whole work, $400, ...	415 93	25
Sept. 8, 1913	Nov. 22, 1913	For each bound, $1.10, ...	440 00	26
Dec. 4, 1913	-	For whole work, $350, ...	-	27
			$211,921 10	

[1] Competitive bids were not received.

CONTRACTS MADE AND PENDING DURING THE YEAR 1913 — WATER WORKS — *Concluded.*

Summary of Contracts.*

	Value of Work done Dec. 31, 1913.
Distribution Department, 5 contracts	[illegible]
262 contracts completed from 1895 to 1912, inclusive,	[illegible]
	[illegible]
Deduct for work done on [illegible] Sudbury Reservoir contracts by the city of Boston,	[illegible]
Total of 267 contracts,	[illegible]

* In this summary contracts charged to maintenance are excluded.

APPENDIX No. 2.

TABLE No. 1. — *Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, in 1913.*

PLACE.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
Wachusett Watershed.	Princeton,	3.70	2.41	5.29	3.67	3.30	0.67	1.87	3.58	4.13	6.11	2.90	2.39	40.02
	Jefferson,	3.52	2.60	6.28	3.96	4.09	1.27	3.67	3.26	5.93	6.42	2.64	3.13	46.77
	Sterling,	3.01	2.54	5.56	3.90	3.59	0.62	1.74	3.10	3.77	5.51	2.35	2.26	37.95
	Boylston,	3.27	2.66	5.18	4.07	3.86	1.05	2.20	2.27	3.92	6.05	2.48	3.13	40.14
Sudbury Watershed.	Sudbury Dam,	2.93	2.79	5.43	4.19	3.99	1.57	3.80	3.24	3.50	5.31	2.42	3.06	42.23
	Framingham,	2.96	2.72	5.63	3.96	3.79	2.02	4.02	4.56	3.89	5.31	2.44	3.15	44.45
	Ashland Dam,	3.40	2.81	5.92	4.34	3.92	2.14	2.23	3.49	3.56	5.31	2.65	3.14	42.91
	Cordaville,	3.40	2.95	6.04	4.51	4.16	2.17	4.37	3.28	4.13	6.17	3.09	3.36	47.63
Lake Cochituate,		2.89	2.80	5.59	4.05	3.70	0.86	3.03	4.36	3.67	5.80	2.23	3.05	42.03
Chestnut Hill Reservoir,		3.38	2.71	5.42	4.90	3.46	1.04	2.25	4.56	3.07	6.48	2.69	3.33	43.29
Spot Pond,		3.49	2.59	4.80	4.31	3.83	1.55	3.88	3.39	2.96	6.83	2.45	3.10	43.18
Average of all,		3.27	2.69	5.56	4.17	3.79	1.36	3.00	3.55	3.87	5.93	2.58	3.01	42.78
Average, Wachusett watershed,		3.38	2.55	5.58	3.90	3.71	0.90	2.37	3.05	4.44	6.02	2.59	2.73	41.22
Average, Sudbury watershed,		3.17	2.82	5.75	4.25	3.97	1.98	3.60	3.64	3.77	5.53	2.65	3.18	44.31

TABLE NO. 2. — *Rainfall in Inches at Jefferson, Mass., in 1913.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	-	-	0.20	-	-	-	-	-	-	-	-	-
2,	-	-	0.06[1]	-	-	-	-	0.04	-	1.00	-	-
3,	0.53	0.52[1]	[2]	-	-	-	-	-	-	-	-	-
4,	-	-	[2]	-	-	-	-	0.27	[2]	-	0.05	-
5,	-	-	0.25	0.31	-	-	-	-	1.67	-	-	-
6,	-	-	0.31[1]	-	0.09	-	0.29	-	-	[2]	-	-
7,	[2]	-	-	0.10	-	0.79	-	-	-	[2]	-	1.05[3]
8,	1.22[3]	-	-	-	-	-	0.08	-	-	[2]	[2]	[2]
9,	-	-	-	-	-	-	0.19	0.35	-	[2]	1.00	[2]
10,	-	-	-	-	-	-	-	-	-	[2]	-	0.06[3]
11,	0.20	0.34[1]	0.38[3]	[2]	-	-	-	-	-	[2]	-	-
12,	0.22	-	-	1.74	-	-	0.15	-	-	0.66	-	-
13,	-	-	-	[2]	-	-	[2]	-	0.37	0.15	-	-
14,	-	-	0.72	0.72	-	-	0.49	-	-	0.11	0.19	-
15,	-	-	0.20	-	-	-	-	-	-	-	-	-
16,	-	-	-	0.49	0.34	-	-	-	-	0.08	0.08[3]	
17,	0.04	-	-	-	-	-	-	-	-	-	-	
18,	0.07	-	-	-	-	-	0.15	0.52	0.30	-	-	-
19,	-	-	-	-	-	0.48	-	-	[2]	[2]	[2]	-
20,	[2]	-	0.55	-	-	-	0.07	-	[2]	1.33	0.34	-
21,	0.27	-	0.11	-	-	-	-	-	[2]	-	-	-
22,	-	0.74	-	-	[2]	-	-	-	3.59	-	-	-
23,	0.34[3]	-	-	-	[2]	-	-	0.77	-	-	-	[2]
24,	-	-	0.26	-	2.43	-	0.23	-	-	[2]	-	1.03[3]
25,	-	-	[2]	-	-	-	-	-	-	[2]	-	[2]
26,	-	[2]	[2]	-	-	-	-	-	-	[2]	-	0.99[3]
27,	0.09	[2]	2.88	-	[2]	-	-	0.22	-	3.09	-	-
28,	-	1.00[3]	-	0.49	[2]	-	1.14	-	-	-	[2]	-
29,	0.11[1]	-	-	0.11	1.23	-	0.97	0.54	-	-	0.98[3]	-
30,	-	-	[2]	-	-	-	-	0.55	-	-	-	-
31,	0.43[3]	-	0.36	-	-	-	-	-	-	-	-	-
Totals,	3.52	2.60	6.28	3.96	4.09	1.27	3.67	3.26	5.93	6.42	2.64	3.13

Total for the year 46.77 inches.

[1] Snow. [2] Rainfall included in that of following day. [3] Rain and snow.

TABLE NO. 3. — *Rainfall in Inches at Framingham, Mass., in 1913.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	-	-	0.18	-	-	-	-	-	-	[2]	-	-
2,	-	-	0.01[1]	-	-	-	-	0.77	-	0.57	-	-
3,	0.52	0.57[1]	-	-	-	-	-	-	-	-	-	-
4,	-	-	0.02[1]	0.02	-	-	-	0.49	[2]	0.02	0.04	-
5,	-	-	-	0.29	-	-	-	-	1.11	-	-	-
6,	-	-	0.31[3]	0.03[3]	0.03	-	0.01	0.03	-	0.01	-	-
7,	[2]	-	-	0.03[1]	-	0.51	-	-	-	[2]	-	[2]
8,	1.13[3]	-	-	-	-	-	-	-	-	[2]	[2]	1.18[3]
9,	-	-	-	-	-	-	[2]	-	-	[2]	0.80	-
10,	[2]	-	-	-	-	-	0.64	0.01	-	[2]	-	-
11,	[2]	0.15[1]	0.35	[2]	-	-	-	-	-	[2]	-	-
12,	0.21	-	-	[2]	-	-	0.05	-	0.17	0.75	-	-
13,	-	-	[2]	[2]	-	-	-	1.07	-	-	-	-
14,	-	-	0.71	2.33	-	-	0.03	-	-	0.39	0.06	-
15,	-	-	[2]	[2]	-	-	-	-	-	[2]	[2]	-
16,	[2]	[2]	0.35	0.65	0.32	-	-	-	-	0.45	0.23[3]	-
17,	0.09	0.05[1]	-	-	-	-	-	-	-	-	-	-
18,	0.03	-	-	[2]	-	-	0.22	0.33	[2]	0.02	-	-
19,	-	-	-	0.05	-	[2]	-	-	[2]	[2]	[2]	-
20,	-	-	0.65	-	-	[2]	0.05	-	[2]	1.08	0.17	-
21,	0.20	[2]	0.11	-	[2]	1.37	-	-	[2]	-	-	-
22,	-	[2]	-	-	[2]	-	-	-	2.61	-	-	-
23,	0.20	0.93[3]	0.06	0.07	[2]	-	-	0.42	-	-	-	[2]
24,	-	-	-	-	2.68	-	1.36	-	-	[2]	-	1.02
25,	-	-	[2]	-	-	0.14	-	-	-	[2]	-	[2]
26,	-	[2]	[2]	-	-	-	-	-	-	2.00	-	0.95[3]
27,	0.01	[2]	2.66	-	[2]	-	-	0.06	-	-	-	-
28,	-	1.02[3]	-	[2]	0.75	-	1.34	-	-	0.02	[2]	-
29,	0.10[1]	-	-	0.49	0.01	-	0.10	[2]	-	-	[2]	-
30,	0.01	-	-	-	-	-	0.22	1.38	-	-	1.14[3]	-
31,	0.46	-	0.22	-	-	-	-	-	-	-	-	-
Totals,	2.96	2.72	5.63	3.96	3.79	2.02	4.02	4.56	3.89	5.31	2.44	3.15

Total for the year 44.45 inches.

[1] Snow. [2] Rainfall included in that of following day. [3] Rain and snow.

TABLE NO. 4. — *Rainfall in Inches at Chestnut Hill Reservoir in 1913.*

DATE.	Amount.	Duration.
Jan. 3, . .	.65	2.15 A.M. to 7.30 P.M.
Jan. 7, . .	1.25[2]	9.00 A.M. to
Jan. 8, . .		3.30 P.M.
Jan. 11, . .	.13	1.35 A.M. to 7.30 A.M.
Jan. 11, . .	.10	8.30 P.M. to
Jan. 12, . .		3.30 P.M.
Jan. 17, . .	.12	4.30 A.M. to
Jan. 18, . .		6.20 A.M.
Jan. 18, . .	.04	5.15 P.M. to 8.00 P.M.
Jan. 20, . .	.27	10.00 P.M. to
Jan. 21, . .		9.30 A.M.
Jan. 23, . .	.15	12.50 P.M. to 9.30 P.M.
Jan. 29, . .	.14[1]	10.30 A.M. to
Jan. 30, . .		1.50 A.M.
Jan. 31, . .	.53	7.45 P.M. to
Feb. 1, . .		3.50 A.M.
Total, .	3.38	
Feb. 3, . .	.60[1]	8.00 A.M. to 8.15 P.M.
Feb. 11, . .	.24[2]	6.45 A.M. to 6.00 P.M.
Feb. 16, . .	.11[1]	10.45 P.M. to
Feb. 17, . .		8.15 A.M.
Feb. 21, . .	.90	10.50 P.M. to
Feb. 22, . .		11.50 P.M.
Feb. 26, . .	.15[2]	9.00 P.M. to
Feb. 27, . .		3.40 A.M.
Feb. 27, . .	.71	6.05 A.M. to
Feb. 28, . .		12.30 A.M.
Total, .	2.71	
Mar. 1, . .	.23	12.30 P.M. to 6.00 P.M.
Mar. 6, . .	.29	11.55 A.M. to 3.15 P.M.
Mar. 11, . .	.44	12.20 A.M. to 9.00 A.M.
Mar. 13, . .	1.05	3.40 P.M. to
Mar. 16, . .		7.45 A.M.
Mar. 20, . .	.52	8.00 A.M. to 8.30 P.M.
Mar. 21, . .	.09	4.30 P.M. to 10.00 P.M.
Mar. 24, . .	.04	12.05 A.M. to 3.35 A.M.
Mar. 25, . .	2.52	7.00 P.M. to
Mar. 27, . .		6.15 P.M.
Mar. 30, . .	.24	11.55 P.M. to
Mar. 31, . .		8.00 P.M.
Total, .	5.42	
Apr. 3, . .	.04	11.00 P.M. to 11.30 P.M.
Apr. 5, . .	.41	12.45 A.M. to 7.30 A.M.
Apr. 7, . .	.16[2]	3.35 A.M. to 6.00 P.M.
Apr. 11, . .	2.69	5.30 A.M. to
Apr. 14, . .		1.20 A.M.
Apr. 15, . .	.91	8.00 P.M. to
Apr. 16, . .		4.30 P.M.
Apr. 18, . .	.07	9.15 P.M. to
Apr. 19, . .		4.50 A.M.
Apr. 23, . .	.13	3.30 A.M. to 7.30 A.M.
Apr. 28, . .	.49	9.30 A.M. to
Apr. 29, . .		8.30 A.M.
Total, .	4.90	
May 9, . .	.04	5.55 A.M. to 8.40 A.M.
May 15, . .	.40	9.15 P.M. to
May 17, . .		11.45 A.M.
May 22, . .	2.20	1.10 A.M. to
May 25, . .		6.15 A.M.
May 28, . .	.78	11.20 A.M. to
May 29, . .		4.50 A.M.
May 29, . .	.04	12.10 A.M. to 5.15 P.M.
Total, .	3.46	
June 2, . .	.04	2.25 A.M. to 3.10 A.M.
June 7, . .	.38	3.00 P.M. to 7.10 P.M.
June 19, . .	.26	5.30 P.M. to
June 21, . .		7.30 P.M.
June 25, . .	.36	9.20 P.M. to 11.40 P.M.
Total, .	1.04	
July 9, . .	.63	10.05 P.M. to
July 10, . .		6.10 A.M.
July 10, . .	.06	8.15 A.M. to 2.00 P.M.
July 14, . .	.10	12.25 A.M. to 12.55 A.M.
July 18, . .	.40	7.45 A.M. to 6.00 P.M.
July 24, . .	.30	2.20 P.M. to
July 25, . .		1.00 A.M.
July 28, . .	.66	3.10 P.M. to 5.00 P.M.
July 30, . .	.10	1.45 P.M. to 2.15 P.M.
Total, .	2.25	
Aug. 2, . .	.59	4.00 A.M. to 5.35 A.M.
Aug. 2, . .	.08	7.30 A.M. to 9.00 A.M.
Aug. 4, . .	.25	10.25 A.M. to 7.45 P.M.
Aug. 10, . .	.06	5.45 P.M. to 6.30 P.M.
Aug. 13, . .	.80	2.45 P.M. to 5.45 P.M.
Aug. 18, . .	.95	2.30 P.M. to 3.30 P.M.
Aug. 23, . .	.37	3.30 A.M. to 8.30 A.M.
Aug. 27, . .	.44	6.40 P.M. to 8.30 P.M.
Aug. 29, . .	1.02	6.10 A.M. to 3.25 A.M.
Aug. 30, . .		
Total, .	4.56	
Sept. 4, .	1.01	9.00 A.M. to
Sept. 5, .		7.45 A.M.
Sept. 8, .	.02	2.10 P.M. to 2.25 P.M.
Sept. 13, .	.15	12.50 A.M. to 5.35 A.M.
Sept. 18, .	.63	1.45 A.M. to 9.30 A.M.
Sept. 19, .	.80	7.15 A.M. to
Sept. 22, .		2.50 A.M.
Sept. 22, .	.46	8.00 A.M. to 8.30 P.M.
Total, .	3.07	

[1] Snow.

[2] Rain and snow.

TABLE No. 4. — *Rainfall in Inches at Chestnut Hill Reservoir in 1913* — Concluded.

DATE.	Amount.	Duration.
Oct. 2, .	.65	2.20 A.M. to 2.45 P.M.
Oct. 4, .	.24	10.00 A.M. to 3.00 P.M.
Oct. 6, .	.90	5.10 A.M. to 1,45 P.M.
Oct. 12, .		
Oct. 14, .	.80	11.30 A.M. to 3.10 A.M.
Oct. 15, .		
Oct. 15, .	.82	2.30 P.M. to 3.15 P.M.
Oct. 16, .		
Oct. 19, .	1.60	2.35 P.M. to 9.30 P.M.
Oct. 20, .		
Oct. 24, .	1.47	9.45 A.M. to 11.40 P.M.
Oct. 26, .		
Total,	6.48	
Nov. 4,	.05	6.20 A.M. to 8.45 A.M.
Nov. 9,	.79	6.00 A.M. to 10.30 P.M.
Nov. 14,	.10	10.15 A.M. to 5.30 P.M.
Nov. 16,	.25[2]	3.45 A.M. to 10.45 P.M.
Nov. 19,	.20	11.35 P.M. to 3.25 A.M.
Nov. 20,		
Nov. 28,	1.30	7.15 P.M. to 9.30 P.M.
Nov. 29,		
Total,	2.69	
Dec. 7, .	1.20	7.10 A.M. to 5.15 A.M.
Dec. 8, .		
Dec. 8, .	.05[1]	10.30 A.M. to 3.30 P.M.
Dec. 23, .	.98	6.00 P.M. to 6.00 A.M.
Dec. 24, .		
Dec. 25, .	.87[2]	1.50 P.M. to 12.30 A.M.
Dec. 26, .		
Dec. 26, .	.19	12.30 A.M. to 1.40 P.M.
Dec. 26, .	.04[1]	1.40 P.M. to 7.30 P.M.
Total,	3.33	

Total for year 43.29 inches.

[1] Snow.

[2] Rain and snow.

TABLE No. 5. — *Rainfall in Inches on the Wachusett Watershed,*[1] *1897 to 1913.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897,	3.46	2.86	4.01	2.33	5.06	5.11	8.65	3.47	1.93	0.94	7.02	6.41	51.84
1898,	6.65	3.30	2.27	4.43	3.38	3.11	3.01	10.61	3.18	7.21	6.81	3.99	57.95
1899,	2.93	5.12	6.75	1.94	1.33	5.51	3.82	3.20	4.11	2.72	1.94	2.08	41.45
1900,	4.56	8.69	6.19	2.76	4.34	3.50	3.30	3.18	3.46	2.90	6.44	6.18	55.46
1901,	1.75	1.13	5.83	9.64	7.02	1.81	5.06	4.88	3.10	3.70	2.43	9.36	55.71
1902,	2.72	4.91	5.37	4.36	2.34	2.51	3.87	3.96	4.26	6.36	0.98	7.90	49.54
1903,	2.85	4.42	6.58	3.10	1.24	10.87	3.43	2.88	2.93	4.48	3.80	3.99	49.88
1904,	4.03	2.66	3.40	7.45	2.90	3.44	3.84	5.08	5.80	1.78	1.08	2.88	44.34
1905,	6.10	1.72	3.95	3.60	0.83	4.88	5.30	3.00	6.90	1.81	2.88	3.79	46.88
1906,	2.59	2.74	5.17	3.12	6.58	5.06	5.42	4.84	3.01	3.08	3.98	4.96	49.08
1907,	2.84	2.32	1.82	2.65	2.96	3.54	3.03	1.26	6.80	5.08	5.74	4.40	45.74
1908,	3.40	4.82	2.77	2.62	5.34	1.20	3.85	6.40	1.04	2.18	1.08	3.08	37.88
1909,	3.52	6.10	4.38	5.71	2.65	3.03	4.25	3.59	5.90	1.70	1.08	3.98	44.90
1910,	5.86	5.24	1.09	3.01	2.18	4.36	1.59	3.87	2.80	1.40	4.17	2.84	37.86
1911,	2.91	2.43	3.70	2.22	1.59	2.37	2.58	5.46	3.04	3.84	4.14	3.01	38.78
1912,	2.57	2.42	5.60	4.06	5.76	0.48	2.65	2.80	3.17	2.58	4.08	4.98	40.10
1913,	3.38	2.55	5.58	3.90	3.71	0.90	2.87	2.05	4.44	6.08	2.80	2.78	41.98
Totals,	62.11	63.43	74.53	65.89	59.15	61.95	66.60	70.59	64.70	60.50	58.81	71.61	779.30
Average (17 years),	3.65	3.73	4.38	3.88	3.48	3.64	3.92	4.15	3.81	3.56	3.46	4.21	45.84

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[1] Means of observations at four places, as follows: January, 1897, to December, 1900, Princeton, Jefferson, Sterling and South Clinton; January, 1901, to December, 1913, Princeton, Jefferson, Sterling and Boylston.

TABLE No. 6. — *Rainfall in Inches on the Sudbury Watershed,*[1] *1875 to 1913.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875,	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876,	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.62	2.24	5.76	3.62	49.56
1877,	3.22	0.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	0.87	44.02
1878,	5.63	5.97	4.69	5.79	0.96	3.88	2.07	6.94	1.29	6.42	7.02	6.37	57.93
1879,	2.48	3.56	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880,	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881,	5.56	4.65	5.73	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882,	5.95	4.55	2.65	1.82	5.07	1.66	1.77	1.67	8.74	2.07	1.15	2.30	39.40
1883,	2.81	3.87	1.78	1.84	4.19	2.40	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884,	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885,	4.71	3.87	1.07	3.60	3.48	2.87	1.43	7.18	1.43	5.09	6.09	2.72	43.54
1886,	6.36	6.28	3.61	2.22	3.00	1.47	3.27	4.10	2.90	3.24	4.64	4.97	46.06
1887,	5.20	4.78	4.90	4.27	1.16	2.65	3.76	5.28	1.32	2.83	2.67	3.88	42.70
1888,	4.15	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889,	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890,	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	10.51	1.20	5.31	53.00
1891,	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.52
1892,	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.17	5.80	1.13	41.83
1893,	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894,	4.09	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74

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[1] See note at end of this table.

TABLE No. 6. — *Rainfall in Inches on the Sudbury Watershed,*[1] *1875 to 1913* — Concluded.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1895,	4.06	1.39	2.98	5.36	2.09	2.77	5.04	4.15	2.30	10.08	3.03	3.58	46.80
1896,	2.39	7.18	5.24	1.87	2.57	3.22	2.51	2.40	7.72	3.70	3.10	2.12	48.50
1897,	4.00	2.91	3.06	2.82	4.37	4.46	5.44	3.51	2.04	0.47	3.40	5.61	48.18
1898,	6.83	4.40	2.40	4.66	3.22	2.48	4.00	8.17	2.09	3.71	3.23	3.64	53.88
1899,	4.18	4.91	7.01	1.90	1.45	2.51	3.22	1.48	3.05	2.00	2.18	1.76	42.41
1900,	4.96	9.14	6.35	2.58	4.32	2.00	2.49	2.96	3.86	3.53	5.70	2.74	50.58
1901,	1.82	1.52	6.57	3.60	7.28	1.88	5.71	4.57	3.30	2.52	2.00	2.88	58.11
1902,	2.52	6.18	5.34	4.18	1.86	2.80	2.04	3.40	4.54	4.44	1.45	3.45	48.07
1903,	3.80	3.95	6.09	2.00	0.98	9.95	2.77	3.07	1.75	4.74	1.50	4.14	48.18
1904,	4.87	3.00	2.72	3.87	2.05	2.80	1.06	3.80	5.30	1.04	1.70	2.02	42.84
1905,	5.26	2.20	3.15	2.72	1.81	5.00	5.47	2.70	3.88	1.54	3.17	4.11	44.41
1906,	2.47	2.02	6.82	2.88	5.06	3.01	3.49	3.09	3.30	3.40	2.00	4.40	44.48
1907,	3.28	2.17	1.01	3.41	3.08	3.38	1.86	1.07	3.76	4.17	6.12	4.47	44.48
1908,	3.60	4.56	3.82	1.88	5.51	0.86	3.71	4.57	0.97	0.55	0.08	3.14	38.15
1909,	3.98	5.70	4.26	4.07	2.48	2.81	1.50	2.08	4.74	1.13	3.38	4.05	41.78
1910,	5.30	5.06	0.86	2.75	1.90	4.08	2.08	2.09	2.40	1.86	4.13	2.40	38.84
1911,	2.88	2.77	3.50	2.81	1.01	2.58	3.10	4.04	2.75	3.00	4.09	3.01	38.38
1912,	2.94	2.77	6.46	4.37	4.55	0.46	3.24	3.05	1.70	2.55	3.04	5.19	40.78
1913,	3.17	2.82	5.75	4.25	3.07	1.08	3.00	3.04	3.77	5.58	2.05	3.18	44.81
Totals,	159.16	161.20	173.90	137.90	120.08	118.84	138.22	150.30	135.00	159.07	148.08	140.09	1,734.88
Average (39 years),	4.08	4.13	4.46	3.54	3.33	3.05	3.55	3.85	3.46	4.08	3.80	3.59	44.50

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[1] Means of observations at several places, as follows: January, 1875, to March, 1876, inclusive, Lake Cochituate; April and May, 1876, Lake Cochituate, Westborough and Hopkinton; June to November, 1876, inclusive, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to December, 1882, inclusive, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to December, 1889, inclusive, Framingham and Westborough; January, 1890, to May, 1898, inclusive, Framingham and Ashland Dam; June, 1898, to December, 1913, inclusive, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

Table No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile*[1] *from 1897 to 1913.*

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
January,	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000	1,265,000	659,000	1,266,000
February,	931,000	1,635,000	1,090,000	4,064,000	356,000	1,401,000	2,133,000	927,000	452,000
March,	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000	3,423,000	3,008,000	3,004,000
April,	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000	2,238,000	2,984,000	1,617,000
May,	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000	569,000	1,498,000	445,000
June,	1,181,000	828,000	561,000	578,000	965,000	410,000	2,131,000	762,000	542,000
July,	1,442,000	333,000	354,000	217,000	477,000	292,000	624,000	497,000	365,000
August,	896,000	1,325,000	236,000	197,000	512,000	297,000	474,000	355,000	321,000
September,	380,000	676,000	250,000	127,000	320,000	241,000	375,000	494,000	1,228,000
October,	243,000	1,509,000	245,000	282,000	647,000	950,000	689,000	347,000	307,000
November,	1,283,000	2,170,000	430,000	875,000	517,000	635,000	634,000	343,000	442,000
December,	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000	954,000	440,000	1,018,000
Average,	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000	1,285,000	1,025,000	926,000
Average, driest six months,	886,000	1,013,000	312,000	377,000	576,000	471,000	626,000	413,000	541,000

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[1] See note at end of this table.

Table No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile*[1] *from 1897 to 1913* — Concluded.

Month.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	Mean for 17 Years, 1897-1913.
January,	1,132,000	1,458,000	1,738,000	592,000	1,846,000	773,000	780,000	1,414,000	1,198,000
February,	1,027,000	692,000	1,736,000	2,556,000	1,845,000	625,000	927,000	867,000	1,367,000
March,	1,860,000	1,697,000	2,192,000	2,129,000	2,640,000	1,339,000	2,831,000	2,263,000	2,673,000
April,	2,109,000	1,436,000	1,269,000	2,422,000	1,034,000	1,393,000	2,281,000	2,063,000	2,154,000
May,	1,533,000	965,000	1,415,000	1,212,000	608,000	461,000	1,797,000	1,038,000	1,182,000
June,	1,184,000	773,000	403,000	632,000	824,000	351,000	331,000	280,000	750,000
July,	728,000	335,000	220,000	233,000	62,000	57,000	135,000	19,000	376,000
August,	591,000	87,000	443,000	193,000	186,000	188,000	125,000	60,000	383,000
September,	277,000	810,000	88,000	208,000	145,000	181,000	89,000	219,000	359,000
October,	530,000	1,382,000	158,000	90,000	68,000	718,000	145,000	678,000	532,000
November,	749,000	2,540,000	125,000	363,000	354,000	1,035,000	442,000	660,000	800,000
December,	794,000	1,961,000	387,000	537,000	391,000	1,067,000	793,000	955,000	1,214,000
Average,	1,043,000	1,180,000	847,000	918,000	828,000	682,000	891,000	879,000	1,081,000
Average, driest six months,	613,000	725,000	238,000	270,000	201,000	327,000	210,000	318,000	532,000

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[1] The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902 inclusive, 2.4 per cent. in 1903, 3.6 per cent. in 1904, 4.1 per cent. in 1905, 5.1 per cent. in 1906, 6.0 per cent. in 1907, 7.0 per cent. in 1908, 1909, and 1910, 6.5 per cent. in 1911, 6.8 per cent. in 1912 and 6.9 per cent in 1913.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile*[1] *from 1875 to 1913.*

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
January, ...	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000	2,589,000
February, ...	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,801,000	2,829,000
March, ...	1,604,000	4,435,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000	2,868,000
April, ...	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000	2,620,000
May, ...	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	937,000	1,030,000	1,336,000	720,000	1,009,000
June, ...	870,000	222,000	597,000	506,000	413,000	175,000	1,338,000	529,000	300,000	416,000	426,000	203,000	413,000
July, ...	321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000	116,000	115,000
August, ...	396,000	405,000	121,000	476,000	395,000	119,000	148,000	55,000	79,000	257,000	240,000	94,000	214,000
September, ...	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000	117,000	111,000
October, ...	646,000	234,000	631,000	516,000	71,000	102,000	186,000	299,000	186,000	83,000	336,000	146,000	190,000
November, ...	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000	673,000	369,000
December, ...	584,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000	1,020,000	643,000
Average, ...	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000	1,087,000	1,154,000
Average, driest six months, .	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000	223,000	234,000

[1] See note at end of this table.

TABLE No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile*[1] *from 1897 to 1913* — Concluded.

MONTH.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	Mean for 17 Years, 1897-1913.
January,	1,132,000	1,458,000	1,738,000	592,000	1,846,000	773,000	780,000	1,414,000	1,198,000
February,	1,027,000	692,000	1,736,000	2,556,000	1,845,000	625,000	927,000	867,000	1,367,000
March,	1,860,000	1,697,000	2,192,000	2,129,000	2,640,000	1,339,000	2,831,000	2,263,000	2,673,000
April,	2,109,000	1,436,000	1,269,000	2,422,000	1,034,000	1,393,000	2,281,000	2,063,000	2,154,000
May,	1,533,000	965,000	1,415,000	1,212,000	608,000	461,000	1,797,000	1,038,000	1,182,000
June,	1,184,000	773,000	403,000	632,000	824,000	351,000	331,000	280,000	750,000
July,	728,000	335,000	220,000	233,000	62,000	57,000	135,000	19,000	376,000
August,	591,000	87,000	443,000	193,000	186,000	188,000	125,000	60,000	382,000
September,	277,000	810,000	88,000	208,000	145,000	181,000	89,000	219,000	359,000
October,	530,000	1,382,000	158,000	90,000	68,000	718,000	145,000	678,000	532,000
November,	749,000	2,540,000	125,000	363,000	354,000	1,035,000	442,000	660,000	800,000
December,	794,000	1,961,000	387,000	537,000	391,000	1,067,000	793,000	955,000	1,214,000
Average,	1,043,000	1,180,000	847,000	918,000	828,000	682,000	891,000	879,000	1,081,000
Average, driest six months,	613,000	725,000	238,000	270,000	201,000	327,000	210,000	318,000	532,000

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[1] The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902 inclusive, 2.4 per cent. in 1903, 3.6 per cent. in 1904, 4.1 per cent. in 1905, 5.1 per cent. in 1906, 6.0 per cent. in 1907, 7.0 per cent. in 1908, 1909, and 1910, 6.5 per cent. in 1911, 6.8 per cent. in 1912 and 6.9 per cent in 1913.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile*[1] *from 1875 to 1913* — Concluded.

MONTH.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	Mean for 39 Years. 1875-1913.
January,	437,000	1,763,000	1,736,000	477,000	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000	519,000	728,000	1,041,000	1,192,000
February,	300,000	1,674,000	2,279,000	882,000	330,000	1,041,000	624,000	1,536,000	2,286,000	1,849,000	700,000	1,197,000	754,000	1,696,000
March,	2,755,000	4,199,000	3,454,000	2,999,000	2,497,000	2,409,000	1,658,000	2,257,000	1,734,000	1,954,000	1,144,000	3,092,000	2,090,000	2,780,000
April,	4,204,000	1,885,000	2,261,000	3,294,000	1,643,000	1,949,000	1,607,000	1,117,000	1,721,000	667,000	1,426,000	2,235,000	2,232,000	2,002,000
May,	2,954,000	743,000	351,000	1,745,000	297,000	1,059,000	888,000	1,046,000	1,004,000	277,000	318,000	1,447,000	867,000	1,062,000
June,	753,000	303,000	1,987,000	419,000	467,000	707,000	761,000	194,000	239,000	516,000	213,000	148,000	149,000	489,000
July,	306,000	66,000	445,000	62,000	177,000	398,000	9,000	—14,000	—121,000	—102,000	—14,000	—77,000	—62,000	154,000
August,	424,000	135,000	307,000	170,000	114,000	180,000	—104,000	102,000	—45,000	—73,000	20,000	—29,000	—54,000	227,000
September,	305,000	178,000	130,000	397,000	1,246,000	19,000	541,000	—82,000	149,000	5,000	76,000	—28,000	88,000	235,000
October,	412,000	506,000	492,000	191,000	158,000	301,000	741,000	47,000	—51,000	—51,000	296,000	—14,000	484,000	438,000
November,	474,000	444,000	363,000	289,000	279,000	483,000	1,998,000	71,000	82,000	176,000	593,000	165,000	480,000	779,000
December,	2,695,000	1,779,000	582,000	269,000	887,000	659,000	2,032,000	136,000	263,000	221,000	908,000	494,000	732,000	995,000
Average,	1,342,000	1,140,000	1,190,000	931,000	795,000	860,000	1,010,000	694,000	625,000	570,000	514,000	779,000	733,000	1,000,000
Average, driest six months,	445,000	271,000	388,000	228,000	403,000	341,000	471,000	44,000	40,000	29,000	151,000	26,000	180,000	385,000

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[1] The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and was subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894, and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

NOTE. — The recorded yields, subsequent to the year 1897, are less accurate than those for previous years, particularly during months of small yield, due to unavoidable inaccuracies in the measurement of large quantities of water received from the Wachusett Reservoir.

TABLE NO. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile*[1] *from 1875 to 1913* — Continued.

MONTH.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
January,	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000	434,000	693,000	1,034,000	1,084,000	845,000	1,638,000	2,288,000	794,000
February,	1,950,000	1,196,000	1,529,000	3,486,000	943,000	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000	1,381,000	3,800,000
March,	3,238,000	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000	4,205,000	3,654,000
April,	2,645,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000	2,521,000	1,350,000
May,	1,632,000	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000	915,000	1,246,000	511,000	1,312,000
June,	421,000	653,000	568,000	413,000	428,000	440,000	419,000	174,000	399,000	962,000	530,000	66,000	316,000
July,	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000	658,000	231,000	19,000	—18,000
August,	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000	591,000	1,107,000	—35,000	—34,000
September,	1,155,000	823,000	457,000	203,000	229,000	108,000	150,000	89,000	388,000	182,000	369,000	94,000	65,000
October,	1,999,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000	94,000	1,160,000	115,000	186,000
November,	2,758,000	1,941,000	1,215,000	305,000	697,000	319,000	836,000	2,777,000	659,000	909,000	1,986,000	304,000	663,000
December,	3,043,000	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000	1,584,000	1,799,000	220,000	1,096,000
Average,	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000	973,000	1,082,000
Average, driest six months,	953,000	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000	564,000	777,000	93,000	194,000

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[1] See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile*[1] *from 1875 to 1913* — Concluded.

MONTH.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	Mean for 39 Years. 1875-1913.
January,	437,000	1,763,000	1,736,000	477,000	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000	519,000	728,000	1,041,000	1,192,000
February,	300,000	1,674,000	2,279,000	882,000	330,000	1,041,000	624,000	1,536,000	2,286,000	1,849,000	700,000	1,197,000	754,000	1,696,000
March,	2,755,000	4,199,000	3,454,000	2,999,000	2,497,000	2,409,000	1,658,000	2,257,000	1,734,000	1,954,000	1,144,000	3,092,000	2,090,000	2,780,000
April,	4,204,000	1,885,000	2,261,000	3,294,000	1,643,000	1,949,000	1,607,000	1,117,000	1,721,000	667,000	1,426,000	2,235,000	2,232,000	2,002,000
May,	2,954,000	743,000	351,000	1,745,000	297,000	1,059,000	888,000	1,046,000	1,004,000	277,000	318,000	1,447,000	867,000	1,062,000
June,	753,000	303,000	1,987,000	419,000	467,000	707,000	761,000	194,000	239,000	516,000	213,000	148,000	149,000	489,000
July,	306,000	66,000	445,000	62,000	177,000	398,000	9,000	—14,000	—121,000	—102,000	—14,000	—77,000	—62,000	154,000
August,	424,000	135,000	307,000	170,000	114,000	180,000	—104,000	102,000	—45,000	—73,000	20,000	—29,000	—54,000	227,000
September,	305,000	178,000	130,000	397,000	1,246,000	19,000	541,000	—82,000	149,000	5,000	76,000	—28,000	88,000	235,000
October,	412,000	506,000	492,000	191,000	158,000	301,000	741,000	47,000	—51,000	—51,000	296,000	—14,000	484,000	438,000
November,	474,000	444,000	363,000	289,000	279,000	483,000	1,998,000	71,000	82,000	176,000	593,000	165,000	480,000	779,000
December,	2,695,000	1,779,000	582,000	269,000	887,000	659,000	2,032,000	136,000	263,000	221,000	908,000	494,000	732,000	995,000
Average,	1,342,000	1,140,000	1,190,000	931,000	795,000	860,000	1,010,000	694,000	625,000	570,000	514,000	779,000	733,000	1,000,000
Average, driest six months,	445,000	271,000	388,000	228,000	403,000	341,000	471,000	44,000	40,000	29,000	151,000	26,000	180,000	385,000

[1] The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and was subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894, and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

NOTE. — The recorded yields, subsequent to the year 1897, are less accurate than those for previous years, particularly during months of small yield, due to unavoidable inaccuracies in the measurement of large quantities of water received from the Wachusett Reservoir.

TABLE No. 9. — *Wachusett System. — Statistics of Flow of Water, Storage and Rainfall in 1913.*

[Watershed above dam = 118.19 square miles.]

MONTH.	GALLONS PER DAY.							Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Discharged into Wachusett Aqueduct.[1]	Diverted to the City of Worcester.	Wasted into River below Dam.	Seepage through the North Dike.	STORAGE.[2] Gain.	STORAGE.[2] Loss.	Total Yield of Watershed.			
January,	72,616,000	10,787,000	1,739,000	835,000	81,142,000	-	167,119,000	3.38	2.522	74.7
February,	98,147,000	1,607,000	1,732,000	850,000	143,000	-	102,479,000	2.55	1.397	54.7
March,	71,161,000	2,207,000	1,771,000	865,000	191,432,000	-	267,436,000	5.58	4.037	72.4
April,	31,340,000	2,327,000	1,900,000	963,000	209,707,000	-	246,237,000	3.90	3.597	92.2
May,	106,042,000	977,000	2,606,000	1,000,000	12,110,000	-	122,735,000	3.71	1.852	49.9
June,	102,464,000	540,000	3,623,000	1,000,000	-	74,547,000	33,080,000	0.90	0.483	53.5
July,	116,309,000	-	3,513,000	968,000	-	118,529,000	2,261,000	2.37	0.034	1.4
August,	99,100,000	-	3,519,000	919,000	-	96,480,000	7,058,000	3.05	0.107	3.5
September,	83,824,000	-	2,560,000	900,000	-	61,447,000	25,837,000	4.44	0.377	8.5
October,	85,865,000	-	2,865,000	877,000	-	9,471,000	80,136,000	6.02	1.209	20.1
November,	71,210,000	9,990,000	1,837,000	873,000	-	5,913,000	77,997,000	2.59	1.139	43.9
December,	81,510,000	3,536,000	1,793,000	874,000	25,184,000	-	112,897,000	2.73	1.704	62.5
Total,	-	-	-	-	-	-	-	41.22	18.458	-
Average for year,	84,997,000	2,667,000	2,460,000	911,000	12,836,000	-	103,871,000	-	-	44.8

[1] Including 167,000 gallons per day drawn from aqueduct for the supply of the Westborough State Hospital.

[2] Aggregate storage in Wachusett Reservoir and in ponds and mill reservoirs.

TABLE No. 10. — *Sudbury System. — Statistics of Flow of Water, Storage and Rainfall in 1913.*

[Watershed from 1875 to 1878 inclusive = 77.764 square miles; in 1879 and 1880 = 78.238 square miles; and from 1881 to 1913 inclusive = 75.2 square miles.]

MONTH.	GALLONS PER DAY.									Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Water received from Wachusett Reservoir.[1]	Water discharged through Sudbury Aqueduct.	Water discharged through Weston Aqueduct.	Water used by Framingham Water Works.	Water diverted from Watershed by Sewers, etc.	Water wasted into River below Lowest Dam.	STORAGE.		Total Yield of Watershed.			
							Gain.	Loss.				
January,	72,455,000	69,481,000	36,761,000	736,000	1,581,000	54,335,000	-	12,142,000	78,297,000	3.17	1.857	58.5
February,	97,979,000	77,154,000	37,261,000	839,000	1,314,000	31,421,000	6,679,000	-	56,689,000	2.82	1.215	43.1
March,	70,994,000	77,332,000	20,084,000	832,000	2,145,000	94,820,000	32,923,000	-	157,142,000	5.75	3.727	64.8
April,	31,170,000	70,447,000	25,277,000	757,000	2,550,000	109,126,000	-	9,170,000	167,817,000	4.25	3.852	90.6
May,	105,878,000	62,758,000	37,603,000	752,000	1,500,000	35,248,000	33,223,000	-	65,206,000	3.97	1.547	39.0
June,	102,310,000	64,437,000	40,200,000	777,000	1,123,000	12,627,000	-	5,667,000	11,187,000	1.98	0.257	13.0
July,	116,145,000	72,793,000	39,384,000	800,000	784,000	1,787,000	-	4,087,000	—4,684,000	3.60	—0.111	—3.1
August,	98,936,000	55,026,000	39,123,000	745,000	781,000	3,361,000	-	4,126,000	—4,026,000	3.64	—0.095	—2.6
September,	83,663,000	49,503,000	39,010,000	797,000	877,000	4,543,000	-	4,450,000	6,617,000	3.77	0.152	4.0
October,	85,700,000	60,177,000	38,716,000	787,000	1,042,000	16,794,000	4,568,000	-	36,384,000	5.53	0.863	15.6
November,	71,033,000	59,300,000	38,730,000	730,000	1,193,000	22,153,000	-	14,983,000	36,090,000	2.65	0.828	31.3
December,	81,326,000	57,816,000	39,278,000	758,000	1,416,000	34,561,000	2,516,000	-	55,019,000	3.18	1.305	41.1
Total,	-	-	-	-	-	-	-	-	-	44.31	15.397	-
Av. for year,	84,830,000	64,624,000	35,943,000	775,000	1,358,000	35,072,000	2,187,000	-	55,129,000	-	-	34.8

[1] Not including 167,000 gallons per day drawn from the Wachusett Aqueduct for the supply of the Westborough State Hospital, which were not discharged into Sudbury Reservoir.

TABLE NO. 11. — *Cochituate System. — Statistics of Flow of Water, Storage and Rainfall in 1913.*

[Watershed of lake = 17.58 square miles.[1]]

MONTH.	GALLONS PER DAY.						Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Water discharged through Cochituate Aqueduct.	Water diverted from Watershed by Sewers, etc.	Water wasted at Outlet of Lake.	STORAGE.		Total Yield of Watershed.			
				Gain.	Loss.				
January,	-	1,026,000	12,058,000	6,058,000	-	19,142,000	2.89	1.94	67.2
February,	-	664,000	11,996,000	1,861,000	-	14,521,000	2.80	1.33	47.5
March,	3,571,000	684,000	25,732,000	5,526,000	-	35,513,000	5.59	3.60	64.5
April,	-	1,843,000	32,854,000	473,000	-	35,170,000	4.05	3.45	85.3
May,	-	948,000	12,610,000	2,684,000	-	16,242,000	3.70	1.65	44.5
June,	-	673,000	3,993,000	-	396,000	4,270,000	0.86	0.42	48.8
July,	-	416,000	-	-	539,000	—123,000	3.08	—0.01	—0.4
August,	10,619,000	423,000	-	-	7,816,000	3,226,000	4.36	0.33	7.5
September,	14,847,000	387,000	-	-	9,657,000	5,577,000	3.67	0.55	14.9
October,	-	584,000	-	9,226,000	-	9,810,000	5.80	1.00	17.2
November,	-	764,000	5,010,000	2,833,000	-	8,607,000	2.23	0.84	37.9
December,	-	948,000	14,916,000	-	761,000	15,103,000	3.05	1.53	50.2
Total,	-	-	-	-	-	-	42.08	16.63	-
Average for year,	2,425,000	779,000	9,908,000	810,000	-	13,922,000	-	-	39.6

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[1] Not including the watersheds of Dudley and Dug ponds.

TABLE NO. 12. — *Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month.*

DATE.	Chestnut Hill Reservoir. Ordinary High Water =134.00.	Lake Cochituate. High Water =144.36.	Farm Pond. High Water =159.25.	Spot Pond. High Water =163.00.	Weston Reservoir. High Water =200.00.	FRAMINGHAM RESERVOIR. No. 1. Flash Boards 169.27.	FRAMINGHAM RESERVOIR. No. 2. Flash Boards 177.12.	FRAMINGHAM RESERVOIR. No. 3. Flash Boards 186.50.	Ashland. Reservoir. Flash Boards 225.23.	Sudbury. Reservoir. Flash Boards 259.97.	Hopkinton Reservoir. Flash Boards 305.00.	Whitehall Reservoir. Ordinary High Water =337.91.	Wachusett Reservoir. Ordinary High Water =395.00.
Jan. 1, 1913, .	133.96	142.05	158.48	163.09	200.00	167.93	176.22	184.95	224.54	256.54	304.37	337.76	383.79
Feb. 1, 1913, .	133.98	142.97	158.49	163.12	199.96	167.88	176.18	184.99	224.53	255.97	304.22	337.00	385.86
Mar. 1, 1913, .	134.04	143.21	158.50	163.12	200.09	167.96	176.25	185.14	224.58	256.26	304.29	337.25	385.75
April 1, 1913, .	133.86	144.00	158.79	162.89	200.29	168.19	176.45	184.67	224.76	258.69	304.50	337.44	390.29
May 1, 1913, .	133.86	144.06	158.84	162.99	198.87	167.91	176.20	184.80	224.54	258.06	304.24	337.56	395.13
June 1, 1913, .	133.99	144.41	158.71	163.18	198.96	169.58	177.40	185.09	225.26	259.88	305.00	337.77	395.38
July 1, 1913, .	133.80	144.36	158.22	162.71	199.78	169.31	177.13	184.96	225.30	259.70	304.96	337.60	393.93
Aug. 1, 1913, .	134.02	144.29	157.79	162.87	199.98	169.33	177.01	184.95	225.18	259.62	304.70	337.38	391.33
Sept. 1, 1913, .	134.05	143.23	159.02	162.92	200.02	169.30	174.14	184.92	225.17	259.56	304.43	337.25	389.08
Oct. 1, 1913, .	133.93	141.83	158.62	162.75	199.93	169.40	174.30	183.64	225.27	259.45	304.42	337.35	387.56
Nov. 1, 1913, .	133.93	143.21	158.63	162.86	199.96	169.55	173.74	184.09	225.33	259.41	305.04	337.84	387.16
Dec. 1, 1913, .	133.94	143.61	158.45	163.01	199.96	169.58	174.52	182.86	225.34	258.57	305.10	337.68	386.90
Jan. 1, 1914, .	133.92	143.51	158.46	163.00	199.99	167.80	177.33	183.00	225.13	258.75	304.81	337.60	387.48

TABLE NO. 13. — *Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District.*

From Wachusett Reservoir into the Wachusett Aqueduct.

MONTH.	Number of Days during which Water was flowing.	ACTUAL TIME.		Million Gallons drawn.
		Hours.	Minutes.	
January,	27	278	50	2,251.1
February,	28	452	46	2,748.1
March,	26	274	30	2,206.0
April,	12	122	40	940.2
May,	30	650	5	3,287.3
June,	27	316	55	3,073.9
July,	21	320	35	3,605.6
August,	21	249	52	3,072.1
September,	21	224	45	2,514.7
October,	25	225	30	2,661.8
November,	24	233	–	2,136.3
December,	26	269	24	2,526.8
Totals,	288	3,618	52	31,023.9

Total actual time, 150.79 days.
Total quantity drawn, 31,023,900,000 gallons.

From Sudbury Reservoir through the Weston Aqueduct to Weston Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January,	31	740	1,139.6
February,	28	672	1,043.3
March,	17	408	622.6
April,	21	496	758.3
May,	31	744	1,165.7
June,	30	720	1,206.0
July,	31	744	1,220.9
August,	31	744	1,212.8
September,	30	720	1,170.3
October,	31	744	1,200.2
November,	30	720	1,161.9
December,	31	744	1,217.6
Totals,	342	8,196	13,119.2

Total actual time, 341.5 days.
Total quantity drawn, 13,119,200,000 gallons.

TABLE No. 13 — *Concluded.*

From Framingham Reservoir No. 3 through the Sudbury Aqueduct to Chestnut Hill Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January,	31	744	2,153.9
February,	28	672	2,160.3
March,	31	744	2,397.3
April,	30	720	2,113.4
May,	31	719	1,945.5
June,	30	720	1,933.1
July,	31	744	2,256.6
August,	30	715	1,705.8
September,	30	720	1,485.1
October,	31	744	1,865.5
November,	30	720	1,779.0
December,	31	744	1,792.3
Totals,	364	8,706	23,587.8

Total actual time, 362.75 days.
Total quantity drawn, 23,587,800,000 gallons.

From Lake Cochituate through the Cochituate Aqueduct to Chestnut Hill Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January,	-	-	-
February,	-	-	-
March,	12	270	110.7
April,	-	-	-
May,	-	-	-
June,	-	-	-
July,	-	-	-
August,	21	497	329.2
September,	29	701	445.4
October,	-	-	-
November,	-	-	-
December,	-	-	-
Totals,	62	1,468	885.3

Total actual time, 61.17 days.
Total quantity drawn, 885,300,000 gallons.

TABLE NO. 14. — *Average Daily Quantity of Water flowing through Aqueducts in 1913 by Months.*[1]

MONTH.	Wachusett Aqueduct into Sudbury Reservoir (Gallons).	Weston Aqueduct into Metropolitan District (Gallons).	Sudbury Aqueduct into Chestnut Hill Reservoir (Gallons).	Cochituate Aqueduct into Chestnut Hill Reservoir (Gallons).
January,	72,455,000	36,761,000	69,481,000	-
February,	97,979,000	37,261,000	77,154,000	-
March,	70,994,000	20,084,000	77,332,000	3,571,000
April,	31,170,000	25,277,000	70,447,000	-
May,	105,878,000	37,603,000	62,758,000	-
June,	102,310,000	40,200,000	64,437,000	-
July,	116,145,000	39,384,000	72,793,000	-
August,	98,936,000	39,123,000	55,026,000	10,619,000
September,	83,663,000	39,010,000	49,503,000	14,847,000
October,	85,700,000	38,716,000	60,177,000	-
November,	71,033,000	38,730,000	59,300,000	-
December,	81,326,000	39,278,000	57,816,000	-
Average,	84,830,000	35,943,000	64,624,000	2,425,000

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[1] Not including quantities wasted while cleaning and repairing aqueducts.

TABLE No. 15. — *Statement of Operation of Engines Nos. 1 and 2 at Chestnut Hill Pumping Station No. 1 for the Year 1913.*

[3 per cent. allowed for slip.]

MONTH.	ENGINE No. 1.			ENGINE No. 2.			Total Quantity pumped (Million Gallons).	Total Coal consumed (Pounds).	Total Ashes and Clinker (Pounds).	Per cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	AVERAGE LIFT (FEET).		Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).						Engine No. 1.	Engine No. 2.		
	Hrs.	Min.		Hrs.	Min.										
January,	189	50	64.78	-	-	-	64.78	148,680	13,000	8.8	435.70	133.99	-	48,630,000	50,140,000
February,	278	45	94.85	-	-	-	94.85	190,320	18,050	9.8	498.37	133.20	-	55,300,000	57,020,000
March,	122	25	43.24	68	50	24.01	67.25	159,050	16,770	10.5	421.23	133.96	132.33	46,790,000	48,250,000
April,	112	50	40.57	-	-	-	40.57	127,425	16,295	12.8	318.38	135.30	-	35,880,000	37,000,000
May,	87	50	30.44	4	45	1.35	31.79	91,090	10,690	11.7	349.00	133.95	131.52	38,920,000	40,130,000
June,	-	-	-	-	-	-	-	29,620[1]	3,620[1]	-	-	-	-	-	-
July,	162	30	57.59	-	-	-	57.59	133,615	17,235	12.9	431.01	134.06	-	48,130,000	49,630,000
August,	129	52	47.15	-	-	-	47.15	101,595	16,490	16.2	464.10	134.01	-	52,040,000	53,660,000
September,	25	15	9.25	-	-	-	9.25	47,870	6,925	14.5	193.23	135.11	-	21,750,000	22,430,000
October,	-	-	-	-	-	-	-	48,170[1]	9,190[1]	-	-	-	-	-	-
November,	-	-	-	-	-	-	-	40,965[1]	6,560[1]	-	-	-	-	-	-
December,	138	10	46.12	-	-	-	46.11	93,759	7,530	8.0	491.79	134 47	-	55,090,000	56,800,000
Total,	1,247	27	433.99	73	35	25.36	459.35	1,212,759	143,015	-	-	-	-	-	-
Average,	-	-	-	-	-	-	-	-	-	11.8	378.76	134.09	132 28	42,270,000	43,580,000

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[1] Used in banking.

TABLE No. 16. — *Statement of Operation of Engine No. 3 at Chestnut Hill Pumping Station No. 1 for the Year 1913.*

[4.4 per cent. allowed for slip.]

MONTH.	Total Pumping Time. Hrs.	Total Pumping Time. Min.	Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
January,	-	-	-	-	-	-	-	-	-	-
February,	-	-	-	-	-	-	-	-	-	-
March,	25	-	20.76	26,035	2,475	9.5	797.39	120.35	79,940,000	83,010,000
April,	3	20	2.80	3,490	100	2.9	802.29	118.70	79,830,000	82,970,000
May,	-	-	-	-	-	-	-	-		
June,	-	-	-	-	-	-	-	-		
July,	-	-	-	-	-	-	-	-		
August,	-	-	-	-	-	-	-	-		
September,	-	-	-	-	-	-	-	-		
October,	-	-	-	-	-	-	-	-	-	
November,	-	-	-	-	-	-	-	-	-	
December,	-	-	-	-	-	-	-	-	-	
Total,	28	20	23.56	29,525	2,575	-	-	-	-	-
Average,	-	-	-	-	-	8.7	797.97	120.15	70,860,000	88,580,000

TABLE No. 17. — *Statement of Operation of Engine No. 4 at Chestnut Hill Pumping Station No. 1 for the Year 1913.*

[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.	SUMMARY OF ENGINES NOS. 1, 2, 3 AND 4. Total Quantity pumped, corrected for Slip (Million Gallons).	SUMMARY OF ENGINES NOS. 1, 2, 3 AND 4. Daily Average Quantity pumped (Million Gallons).
	Hrs.	Min.										
January,	743	-	952.37	656,080	61,985	9.4	1,451.61	119.17	144,100,000	147,000,000	1,017.15	32.811
February,	670	10	856.91	586,035	56,835	9.7	1,462.22	119.92	146,070,000	149,010,000	951.76	33.991
March,	711	55	895.63	623,670	67,605	10.8	1,436.06	119.52	142,970,000	145,840,000	983.64	31.730
April,	385	05	477.76	341,945	37,425	10.9	1,397.18	119.32	138,870,000	141,660,000	521.13	17.371
May,	-	-	-	-	-	-	-	-	-	-	31.79	1.025
June,	-	-	-	-	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	-	-	-	-	57.59	1.858
August,	-	-	-	-	-	-	-	-	-	-	47.15	1.521
September,	-	-	-	-	-	-	-	-	-	-	9.25	.308
October,	-	-	-	-	-	-	-	-	-	-	-	-
November,	-	-	-	-	-	-	-	-	-	-	-	-
December,	639	35	809.15	575,496	63,685	11.1	1,405.99	118.02	138,220,000	141,000,000	855.27	27.589
Total,	3,149	45	3,991.82	2,783,226	287,535	-	-	-	-	-	4,474.73	-
Average,	-	-	-	-	-	10.3	1,434.24	119.19	142,400,000	145,260,000	-	12.260

TABLE NO. 18. — *Statement of Operation of Engines Nos. 5, 6 and 7, at Chestnut Hill Pumping Station No. 2 for the Year 1918.*

[2 per cent. allowed for slip.]

MONTH.	ENGINE NO. 5.		ENGINE NO. 6.		ENGINE NO. 7.		Total Quantity pumped (Million Gallons).	Daily Average Quantity pumped (Million Gallons).	Total Coal consumed (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	AVERAGE LIFT (FEET).			Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).						Engine No. 5.	Engine No. 6.	Engine No. 7.		
	Hrs. Min.		Hrs. Min.		Hrs. Min.											
January,	52 15	54.40	739 50	873.00	336 20	319.08	1,246.48	40.209	459,115	11.9	2,714.96	39.89	39.82	31.98	85,520,000	87,270,000
February,	445 -	477.98	672 -	751.78	51 45	49.12	1,278.88	45.674	494,755	11.6	2,584.88	43.55	41.89	31.97	90,710,000	92,570,000
March,	100 45	103.90	744 -	872.82	529 35	599.52	1,576.24	50.846	529,740	9.6	2,975.50	41.87	38.98	30.06	88,680,000	90,500,000
April,	490 45	566.21	334 05	385.10	323 30	357.35	1,308.66	43.622	447,057	12.1	2,927.28	41.55	39.29	28.66	91,110,000	92,980,000
May,	744 -	884.92	8 25	8.14	270 50	201.37	1,094.43	35.304	395,890	10.9	2,764.48	41.41	47.57	32.59	91,730,000	93,610,000
June,	617 40	725.61	81 30	102.01	308 50	226.40	1,054.02	35.134	360,452	10.8	2,924.16	41.06	43.17	33.16	96,380,000	98,360,000
July,	98 40	95.50	743 -	852.45	326 10	265.88	1,213.83	39.156	451,130	10.8	2,690.64	45.30	45.46	37.78	98,090,000	100,100,000
August,	431 05	533.70	333 10	377.55	300 -	199.93	1,111.18	35.845	411,385	11.5	2,701.07	42.98	42.50	32.57	92,120,000	94,010,000
September,	701 15	790.25	- -	-	298 10	218.99	1,009.24	33.641	371,321	13.1	2,717.97	40.30	-	32.94	87,630,000	89,430,000
October,	181 10	200.16	563 20	598.70	239 50	170.70	969.56	31.276	383,665	12.4	2,527.10	39.44	38.09	32.18	78,580,000	80,190,000
November,	228 35	256.96	492 35	559.11	173 30	125.83	941.90	31.397	382,520	13.6	2,462.36	38.78	39.75	32.27	78,940,000	80,560,000
December,	725 20	802.47	21 55	23.32	157 35	112.25	938.04	30.259	394,065	13.1	2,380.42	38.33	37.96	32.18	74,530,000	76,060,000
Total,	4,816 30	5,492.06	4,733 50	5,403.98	3,316 05	2,846.42	13,742.46	-	5,081,095	-	-	-	-	-	-	-
Average,	- -	-	- -	-	- -	-	-	37.651	-	11.7	2,704.63	40.97	40.88	31.99	88,030,000	89,830,000

TABLE No. 19. — *Statement of Operation of Engine No. 12 at Chestnut Hill Pumping Station No. 2 for the Year 1913.*

[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Hrs.	Min.								
January,	-	-	-	-	-	-	-	-	-	-
February,	-	-	-	-	-	-	-	-	-	-
March,	-	-	-	-	-	-	-	-	-	-
April,	332	30	413.08	271,450	38,940	14.3	1,521.75	119.14	151,020,000	154,090,000
May,	744	-	933.98	590,780	80,950	13.7	1,580.93	119.79	157,750,000	160,950,000
June,	730	-	973.65	615,900	69,145	11.2	1,580.86	122.30	161,050,000	164,320,000
July,	740	55	1,007.13	683,265	83,335	12.2	1,474.00	125.50	154,090,000	157,220,000
August,	744	-	951.92	653,060	86,675	13.3	1,457.63	124.17	150,770,000	153,830,000
September,	719	15	964.47	672,860	87,700	13.0	1,433.39	122.04	145,720,000	148,680,000
October,	741	50	992.34	686,130	90,350	13.2	1,446.29	121.84	146,790,000	149,770,000
November,	719	35	936.40	649,790	89,050	13.7	1,441.08	121.77	146,180,000	149,150,000
December,	105	-	141.41	97,810	12,500	12.8	1,445.76	122.53	147,570,000	150,570,000
Total,	5,567	05	7,314.38	4,921,045	638,645	-	-	-	-	-
Average,	-	-	-	-	-	13.0	1,486.35	122.32	151,450,000	154,520,000

TABLE No. 20. — *Statement of Operation of Engine No. 8 at Spot Pond Pumping Station for the Year 1918.*

[2 per cent. allowed for slip.]

Month.	Total Pumping Time. Hrs.	Total Pumping Time. Min.	Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty on Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal on basis of Plunger Displacement; no Deduction for Heating or Lighting.
January,	14	-	6.01	6,050	980	16.2	993.39	116.91	96,150,000	100,410,000
February,	-	-	-	-						
March,	-	-	-	-						
April,	11	-	4.78	4,940	718	14.5	967.61	111.96	90,300,000	91,410,000
May,	11	-	5.06	4,915	555	11.3	1,029.50	120.14	103,030,000	104,130,000
June,	-	-	-	-	-	-				
July,	-	-	-	-		-				
August,	12	-	5.14	4,910	860	17.5	1,046.84	118.10	103,000,000	104,110,000
September,	-	-	-							
October,	-	-	-	-						
November,	9	45	4.00	4,390	545	12.4	913.24	114.84	87,190,000	89,020,000
December,	-	-	-	-	-					
Total,	57	45	24.99	25,205	3,655					
Average,	-	-	-	-	-	14.5	991.47	116.91	96,500,000	98,850,000

TABLE No. 21. — *Statement of Operation of Engine No. 9 at Spot Pond Pumping Station for the Year 1913.*

[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.	SUMMARY OF ENGINES Nos. 8 AND 9. Total Quantity pumped, corrected for Slip (Million Gallons).	SUMMARY OF ENGINES Nos. 8 AND 9. Daily Average Quantity pumped (Million Gallons).
	Hrs.	Min.										
January,	242	50	203.80	177,981	22,759	12.8	1,145.07	127.68	121,790,000	124,260,000	209.81	6.768
February,	238	45	199.19	173,695	21,486	12.4	1,146.78	127.28	121,590,000	124,060,000	199.19	7.114
March,	250	35	209.07	183,970	24,575	13.4	1,136.44	127.49	120,690,000	123,140,000	209.07	6.744
April,	237	35	198.00	175,098	22,787	13.0	1,130.80	127.13	119,750,000	122,180,000	202.78	6.759
May,	265	25	219.85	189,893	20,117	10.6	1,157.76	128.06	123,500,000	126,010,000	224.91	7.255
June,	302	-	250.51	206,486	24,680	12.0	1,213.21	128.09	129,450,000	132,080,000	250.51	8.350
July,	336	20	279.15	225,310	28,176	12.5	1,238.96	128.20	132,310,000	135,000,000	279.15	9.005
August,	297	15	250.79	205,459	25,135	12.2	1,220.63	126.45	128,570,000	131,180,000	255.93	8.256
September,	257	05	212.45	177,895	20,790	11.7	1,194.24	127.36	126,700,000	129,270,000	212.45	7.082
October,	236	55	193.09	168,985	20,219	12.0	1,142.65	127.64	121,490,000	123,960,000	193.09	6.229
November,	213	20	175.76	154,981	18,233	11.8	1,134.07	127.56	120,500,000	122,950,000	179.76	5.992
December,	226	20	184.23	165,547	19,410	11.7	1,112.86	126.97	117,700,000	120,090,000	184.23	5.943
Total,	3,104	25	2,575.89	2,205,300	268,367	-	-	-	-	-	2,600.88	-
Average,	-	-	-	-	-	12.2	1,168.05	127.51	124,070,000	126,590,000	-	7.126

TABLE No. 22. — *Statement of Operation of Engine No. 10 at Arlington Pumping Station for the Year 1918.*

(2 per cent. allowed for slip.)

Month.	Total Pumping Time. Hrs.	Total Pumping Time. Min.	Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deductions for Banking or [illegible] or [illegible].	Duty in Foot-pounds per 100 Pounds of Coal, in [illegible] [illegible] [illegible] [illegible] or Heating or Lighting.
January,	[illegible]	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February,	[illegible]	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March,	[illegible]	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May,	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June,	477	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July,	[illegible]	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September,	470	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November,	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total,	[illegible]	45	[illegible]	[illegible]	[illegible]					
Average,	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE No. 23. — *Statement of Operation of Engine No. 11 at Arlington Pumping Station for the Year 1913.*

[4 per cent. allowed for slip.]

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.	SUMMARY OF ENGINES NOS. 10 AND 11. Total Quantity pumped, corrected for Slip (Million Gallons).	SUMMARY OF ENGINES NOS. 10 AND 11. Daily Average Quantity pumped (Million Gallons).
	Hrs.	Min.										
January,	-	-	-	-	-	-	-	-	-	-	18.74	.605
February,	-	-	-	-	-	-	-	-	-	-	16.62	.594
March,	-	-	-	-	-	-	-	-	-	-	18.08	.583
April,	-	-	-	-	-	-	-	-	-	-	16.67	.556
May,	245	-	6.75	47,035	4,038	8.6	143.51	283.60	33,910,000	35,490,000	20.47	.660
June,	-	-	-	-	-	-	-	-	-	-	22.82	.761
July,	-	-	-	-	-	-	-	-	-	-	28.87	.931
August,	-	-	-	-	-	-	-	-	-	-	25.87	.834
September,	-	-	-	-	-	-	-	-	-	-	21.06	.702
October,	189	30	5.87	35,235	3,318	9.4	166.60	277.98	38,580,000	40,370,000	22.12	.714
November,	-	-	-	-	-	-	-	-	-	-	18.21	.607
December,	-	-	-	-	-	-	-	-	-	-	18.05	.582
Total,	434	30	12.62	82,270	7,356	-	-	-	-	-	247.58	-
Average,	-	-	-	-	-	8.9	153.40	281.03	35,910,000	37,580,000	-	.678

TABLE NO. 24. — *Statement of Operation of Engines Nos. 13 and 14 at Hyde Park Pumping Station for the Year 1913.*

[2 per cent. allowed for slip.]

MONTH.	ENGINE NO. 13.			ENGINE NO. 14.			Total Quantity pumped (Million Gallons).	Total coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal, no Deduction for Heating or Lighting.	AVERAGE LIFT (FEET).		Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).						Engine No. 13.	Engine No. 14.		
	Hrs.	Min.		Hrs.	Min.										
January,	130	30	6.33	94	50	4.70	11.03	33,437	3,037	9.1	329.87	128.38	128.38	35,290,000	36,050,000
February,	417	55	15.64	97	15	4.63	20.27	54,391	4,248	7.8	372.67	126.22	126.22	39,190,000	40,030,000
March,	342	30	14.66	153	25	7.87	22.53	53,556	5,294	9.9	420.68	126.27	126.27	44,260,000	45,210,000
April,	331	45	14.90	139	15	6.73	21.63	60,359	10,184	16.9	358.19	127.59	127.97	38,110,000	38,930,000
May,	355	-	19.70	132	25	7.29	26.99	58,997	7,985	13.5	457.48	130.21	128.73	49,470,000	50,530,000
June,	394	45	20.75	144	20	6.73	27.48	52,886	4,923	9.3	519.61	128.59	126.84	55,480,000	56,670,000
July,	311	10	18.51	279	25	13.23	31.74	63,380	11,302	17.8	500.79	122.62	118.95	50,520,000	51,610,000
August,	250	15	12.16	296	45	13.02	25.18	59,685	14,057	23.6	421.88	119.22	117.99	41,670,000	42,570,000
September,	353	-	17.06	168	10	8.31	25.37	55,110	7,848	14.2	460.35	124.26	121.17	47,260,000	48,280,000
October,	36	30	1.36	600	50	24.37	25.73	50,708	6,515	12.8	507.41	120.10	118.61	50,720,000	51,810,000
November,	547	35	11.96	277	35	9.85	21.81	43,534	5,804	13.3	500.99	117.11	115.90	48,630,000	49,080,000
December,	338	05	10.65	272	35	9.14	19.79	41,841	5,183	12.4	472.98	116.58	116.13	45,840,000	46,830,000
Total,	3,809	-	163.68	2,647	50	115.87	279.55	627,884	86,380	-	-	-	-	-	-
Average,	-	-	-	-	-	-	-	-	-	13.8	445.23	124.73	121.53	45,770,000	46,750,000

TABLE NO. 25. — (*Meter Basis.*) *Average Daily Consumption of Water by Districts in the Cities and Towns supplied by the Metropolitan Water Works in 1913. (For Consumption of Water in Whole Metropolitan Water District, see Table No. 27.)*

MONTH.	SOUTHERN LOW SERVICE.	NORTHERN LOW SERVICE.	SOUTHERN HIGH SERVICE.	NORTHERN HIGH SERVICE.	SOUTHERN EXTRA HIGH SERVICE.	NORTHERN EXTRA HIGH SERVICE.	Total District supplied (Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
	Boston, excluding East Boston and Charlestown (Gallons).	Portions of Charlestown, Somerville, Chelsea, Everett, Malden, Medford, East Boston and Arlington (Gallons).	Quincy, Watertown, and Portions of Boston, Belmont and Milton (Gallons).	Revere, Winthrop, Swampscott, Nahant, Stoneham, Melrose, and Portions of Boston, Chelsea, Everett, Malden, Medford and Somerville (Gallons).	Portions of Boston and Milton (Gallons).	Lexington and Portions of Arlington and Belmont (Gallons).			
January, ...	49,535,200	20,788,300	30,828,700	6,611,400	770,000	604,700	109,138,300	1,097,600	99
February, ...	52,888,600	22,358,600	31,746,800	6,991,500	721,700	593,500	115,300,700	1,099,640	105
March, ...	45,924,800	20,354,900	29,100,500	6,682,000	722,600	583,300	103,368,100	1,101,670	94
April, ...	43,423,600	19,627,500	28,510,400	6,759,100	717,100	555,600	99,593,300	1,103,710	90
May, ...	43,747,700	19,787,700	28,755,300	7,373,000	798,300	660,400	101,122,200	1,105,740	91
June, ...	43,810,700	20,472,400	30,574,400	8,496,300	911,000	760,500	105,025,300	1,107,780	95
July, ...	44,381,300	21,104,800	31,935,000	9,527,800	990,200	931,400	108,870,500	1,109,810	98
August, ...	43,812,000	19,995,800	29,560,000	8,312,400	807,000	834,600	103,321,800	1,111,850	93
September, . . .	43,919,300	19,840,000	30,046,700	7,671,800	775,100	701,900	102,954,800	1,113,880	92
October, ...	44,441,600	19,286,200	29,694,100	6,830,800	756,700	713,500	101,722,900	1,115,910	91
November, . . .	42,961,000	18,555,300	28,707,400	6,545,900	712,300	606,900	98,088,800	1,117,940	88
December, . . .	42,730,200	18,799,900	29,214,800	6,500,800	632,500	582,300	98,460,500	1,119,970	88
For the year, .	45,085,200	20,067,200	29,879,000	7,361,500	776,600	678,200	103,847,700	1,109,810	94

In addition to the above quantities the United States Government Reservation on Peddocks Island was supplied with 37,262,000 gallons, equivalent to a daily average rate of 102,100 gallons, and a part of Saugus with 4,761,200 gallons, equivalent to a daily average rate of 13,000 gallons.

TABLE No. 26. — (*Meter Basis.*) *Average Daily Consumption of Water in Cities and Towns supplied from Metropolitan Works in 1913.*

City or town, . . .	BOSTON.		SOMERVILLE.		MALDEN.		CHELSEA.		EVERETT.		QUINCY.		MEDFORD.	
Population supplied, .	733,360.		82,310.		47,820.		35,820.		37,300.		35,530.		25,650.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January, ...	85,927,700	118	6,144,100	75	2,010,400	42	2,991,200	85	2,429,400	66	2,350,100	67	1,184,300	47
February, ...	90,321,700	124	6,740,400	82	2,128,200	45	3,071,500	87	2,844,700	77	2,535,900	72	1,236,100	49
March, ...	79,639,300	109	6,219,900	76	2,122,400	45	2,874,500	81	2,460,900	67	2,590,200	74	1,283,800	51
April, ...	75,998,500	104	6,019,800	73	2,145,600	45	2,922,000	82	2,323,100	63	2,638,000	75	1,261,100	50
May, ...	76,646,400	105	6,121,700	74	2,239,500	47	3,025,200	85	2,258,100	61	2,576,700	73	1,244,000	49
June, ...	78,216,700	107	6,337,700	77	2,407,400	50	3,026,000	85	2,489,400	67	2,943,000	83	1,297,100	51
July, ...	80,265,500	109	6,226,500	75	2,432,000	51	3,008,200	84	2,612,100	70	3,257,300	92	1,374,300	54
August, ...	77,452,800	105	5,572,200	67	2,303,800	48	2,828,700	79	2,589,800	69	3,109,800	87	1,212,000	47
September, . . .	78,716,300	107	5,478,400	66	2,296,100	48	2,854,200	79	2,323,500	62	2,754,800	77	1,186,000	46
October, ...	78,738,700	107	5,445,100	65	2,230,500	46	2,762,800	77	2,369,500	60	2,555,200	71	1,206,300	47
November, . . .	75,705,800	103	5,411,700	65	2,220,200	46	2,645,400	73	2,271,400	60	2,469,700	69	1,105,000	46
December, . . .	75,828,000	103	5,835,200	70	2,167,800	45	2,564,000	71	2,288,000	63	2,580,600	72	1,125,400	43
For the year, . .	79,390,600	108	5,958,000	72	2,225,700	46	2,870,800	80	2,435,800	65	2,699,100	76	1,233,700	48

TABLE No. 26. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Continued.

City or town,	MELROSE.		REVERE.		WATERTOWN.		ARLINGTON.		MILTON.		WINTHROP.	
Population supplied,	16,640.		20,720.		14,000.		12,500.		8,470.		11,440.	
	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
MONTH.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	1,059,600	64	1,212,800	60	800,800	58	788,900	60	278,800	33	560,800	49
February,	1,100,700	67	1,385,700	68	832,800	59	709,800	57	288,600	34	566,100	50
March,	1,104,100	67	1,219,300	60	841,700	60	699,200	56	292,700	35	578,800	51
April,	1,174,700	71	1,226,700	60	856,000	61	694,600	56	298,800	35	598,400	52
May,	1,249,100	75	1,358,300	66	872,800	62	760,800	61	335,800	40	650,200	57
June,	1,329,200	80	1,562,400	76	941,400	67	988,800	79	382,700	45	856,700	75
July,	1,364,000	82	1,833,800	89	962,400	68	1,179,000	94	392,200	46	1,079,800	94
August,	1,257,000	75	1,451,800	70	836,900	59	906,100	72	344,300	41	979,700	85
September,	1,201,900	72	1,530,600	74	879,900	62	760,800	60	339,200	40	678,700	59
October,	967,600	58	1,350,700	65	866,100	61	745,600	59	359,000	42	580,900	51
November,	933,900	56	1,244,300	59	861,800	62	666,800	53	347,300	41	580,300	51
December,	896,700	54	1,244,300	59	857,800	60	645,800	51	327,800	39	563,100	49
For the year,	1,136,600	68	1,385,100	67	866,500	62	756,300	60	332,300	39	686,700	60

TABLE No. 26. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Concluded.

City or town,	STONEHAM.		BELMONT.		LEXINGTON.		NAHANT.		SWAMPSCOTT.		METROPOLITAN DISTRICT.	
Population supplied,	7,830.		6,330.		5,400.		1,380.		6,640.		1,100,810.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	408,200	53	355,000	57	285,700	54	60,900	45	354,100	54	100,138,300	99
February,	406,500	53	379,900	61	298,500	56	74,700	55	391,900	59	115,300,700	105
March,	399,500	51	370,400	59	301,900	56	57,500	42	309,300	47	103,368,100	94
April,	395,200	51	386,500	62	337,500	63	78,900	58	313,900	47	99,598,300	90
May,	459,400	59	446,000	71	356,700	66	132,900	97	389,100	59	101,122,200	91
June,	494,800	63	563,300	89	368,500	68	275,200	199	549,100	83	105,028,300	95
July,	511,800	65	728,600	115	469,100	87	479,100	347	694,800	105	108,870,500	98
August,	432,500	55	579,300	91	446,300	82	402,300	289	616,500	93	103,321,800	93
September,	428,600	54	469,500	74	410,400	76	209,500	151	436,400	66	102,954,800	92
October,	389,300	49	434,200	68	359,100	66	108,400	77	343,300	51	101,722,900	91
November,	340,900	43	433,800	68	344,600	63	71,700	51	324,500	49	98,088,800	88
December,	305,900	39	408,800	64	328,800	60	67,300	48	314,100	47	98,460,500	88
For the year,	414,400	53	463,600	73	359,300	67	169,100	123	420,100	63	103,847,700	94

TABLE NO. 27. — (*Pump Basis.*) *Consumption of Water in the Metropolitan Water District, as constituted in the Year 1913, and a Small Section of the Town of Saugus, from 1893 to 1913.*

[Gallons per day.]

MONTH.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January,	75,209,000	67,506,000	68,925,000	82,946,000	85,366,000	83,880,000	96,442,000	100,055,000	111,275,000	118,435,000	125,176,000
February,	71,900,000	68,944,000	80,375,000	87,021,000	83,967,000	87,475,000	103,454,000	98,945,000	117,497,000	117,268,000	122,728,000
March,	67,638,000	62,710,000	69,543,000	86,111,000	82,751,000	85,468,000	90,200,000	97,753,000	105,509,000	108,461,000	111,977,000
April,	62,309,000	57,715,000	62,909,000	77,529,000	79,914,000	76,574,000	86,491,000	89,497,000	93,317,000	103,153,000	107,179,000
May,	61,025,000	60,676,000	65,194,000	73,402,000	76,772,000	76,677,000	89,448,000	87,780,000	95,567,000	106,692,000	111,589,000
June,	63,374,000	68,329,000	69,905,000	77,639,000	77,952,000	83,463,000	97,691,000	98,581,000	103,420,000	110,002,000	105,590,000
July,	69,343,000	73,642,000	69,667,000	80,000,000	85,525,000	88,228,000	96,821,000	107,786,000	106,905,000	108,340,000	107,562,000
August,	66,983,000	67,995,000	72,233,000	78,537,000	84,103,000	87,558,000	92,072,000	102,717,000	102,815,000	107,045,000	103,570,000
September,	64,654,000	67,137,000	73,724,000	74,160,000	84,296,000	88,296,000	91,478,000	103,612,000	102,103,000	107,752,000	106,772,000
October,	63,770,000	62,735,000	67,028,000	71,762,000	79,551,000	81,770,000	89,580,000	98,358,000	103,389,000	106,560,000	103,602,000
November,	61,204,000	62,231,000	64,881,000	71,933,000	72,762,000	78,177,000	86,719,000	93,648,000	101,324,000	105,175,000	103,477,000
December,	66,700,000	65,108,000	70,443,000	79,449,000	76,594,000	86,355,000	85,840,000	97,844,000	113,268,000	125,434,000	114,721,000
Average,	66,165,000	65,382,000	69,499,000	78,360,000	80,793,000	83,651,000	92,111,000	98,059,000	104,645,000	110,345,000	110,277,000
Population,	723,153	743,354	763,557	786,385	809,213	832,042	854,870	877,698	892,740	907,780	922,820
Per capita,	91.5	88.0	91.0	99.7	99.8	100.5	107.8	111.7	117.2	121.6	119.5

See note at end of this table.

TABLE No. 27. — (*Pump Basis.*) *Consumption of Water, etc.* — Concluded.

[Gallons per day.]

MONTH.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
January,	137,771,000	130,878,000	126,093,000	137,730,000	132,376,000	133,373,000	127,568,000	123,341,000	137,377,000	113,429,000
February,	143,222,000	140,595,000	130,766,000	150,822,000	146,190,000	130,763,000	131,093,000	124,359,000	141,440,000	120,718,000
March,	123,334,000	120,879,000	123,570,000	134,302,000	128,884,000	126,843,000	117,078,000	116,669,000	122,804,000	107,871,000
April,	108,688,000	111,898,000	118,428,000	121,556,000	128,926,000	125,335,000	112,775,000	111,656,000	113,808,000	104,096,000
May,	111,715,000	115,804,000	122,404,000	133,502,000	131,040,000	123,305,000	119,073,000	112,095,000	114,548,000	104,311,000
June,	111,209,000	117,441,000	121,883,000	135,633,000	139,843,000	125,179,000	114,082,000	114,145,000	118,793,000	108,183,000
July,	113,584,000	124,769,000	118,726,000	128,779,000	138,232,000	126,765,000	122,743,000	123,053,000	120,361,000	112,084,000
August,	112,836,000	121,158,000	120,591,000	131,098,000	128,078,000	121,721,000	114,373,000	111,091,000	112,968,000	106,660,000
September,	114,188,000	120,103,000	121,685,000	124,751,000	129,972,000	118,043,000	119,434,000	108,726,000	112,852,000	105,449,000
October,	108,290,000	118,301,000	116,561,000	124,051,000	124,189,000	115,939,000	119,332,000	106,478,000	110,220,000	103,756,000
November,	108,054,000	116,693,000	113,746,000	119,627,000	117,110,000	111,664,000	107,598,000	105,873,000	109,989,000	101,441,000
December,	125,119,000	122,696,000	130,995,000	122,407,000	124,468,000	115,733,000	121,904,000	104,592,000	110,114,000	102,480,000
Average,	118,114,000	121,671,000	122,085,000	128,561,000	130,712,000	122,851,000	117,458,000	113,951,000	114,546,000	107,466,000
Population,	937,860	955,920	981,690	1,007,520	1,025,890	1,051,480	1,076,080	1,102,910	1,128,470	1,152,400
Per capita,	125.9	127.3	124.4	127.6	127.4	116.8	109.1	103.4	106.1	93.3

This table includes the water consumed in the cities and towns enumerated in Table No. 23, together with the water consumed in Newton which is included in the Metropolitan Water District but has not been supplied from the Metropolitan Works.

TABLE No. 28. — *Chemical Examinations of Water from the Wachusett Reservoir, Clinton.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
				COLOR.						ALBUMINOID.							
		Turbidity.	Sediment.	Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
105164	Jan. 7	V. slight.	V. slight.	.09	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.20	1.00	.0028	.0132	.0120	.0012	.29	.0010	.0000	.24	0.8
105470	Jan. 21	V. slight.	V. slight.	.09	V. faintly vegetable.	V. faintly vegetable.	2.90	1.15	.0024	.0100	.0086	.0014	.29	.0020	.0000	.26	1.3
105771	Feb. 4	V. slight.	V. slight.	.08	V. faintly vegetable.	Faintly vegetable.	3.30	1.30	.0020	.0112	.0086	.0026	.30	.0020	.0000	.19	0.8
106071	Feb. 18	V. slight.	V. slight.	.08	V. faintly vegetable.	Faintly vegetable.	3.40	1.05	.0020	.0110	.0098	.0012	.31	.0020	.0000	.21	0.8
106353	Mar. 4	V. slight.	V. slight.	.11	V. faintly vegetable.	V. faintly vegetable.	2.90	0.95	.0024	.0160	.0130	.0030	.30	.0020	.0000	.28	1.3
106696	Mar. 18	None.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.25	1.10	.0018	.0116	.0092	.0024	.31	.0010	.0000	.32	1.3
106977	Apr. 1	V. slight.	V. slight.	.11	Faint cucumber odor.	Distinct cucumber odor.	2.70	0.90	.0014	.0132	.0104	.0028	.31	.0010	.0000	.25	1.3
107261	Apr. 15	V. slight.	V. slight.	.12	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.15	1.10	.0018	.0108	.0096	.0012	.31	.0020	.0000	.32	1.3
107623	May 6	V. slight.	Slight.	.14	Distinctly vegetable.	Distinctly vegetable.	3.30	1.10	.0014	.0124	.0100	.0024	.31	.0030	.0000	.24	1.3
107988	May 20	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.00	1.00	.0018	.0114	.0104	.0010	.30	.0020	.0000	.32	1.3
108212	June 3	V. slight.	V. slight.	.12	V. faintly vegetable.	Faintly vegetable.	3.45	1.05	.0012	.0116	.0114	.0002	.31	.0010	.0000	.32	1.3
108474	June 17	V. slight.	V. slight.	.15	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.30	1.00	.0048	.0144	.0124	.0020	.29	.0040	.0001	.24	1.1
108865	June 30	V. slight.	V. slight.	.12	Faintly vegetable.	Distinctly vegetable.	3.15	1.10	.0042	.0180	.0160	.0020	.26	.0000	.0000	.25	0.8
109180	July 15	None.	V. slight.	.12	V. faintly unpleasant.	Faintly unpleasant.	3.45	1.00	.0020	.0138	.0128	.0010	.24	.0000	.0001	.28	1.3
109678	Aug. 1	V. slight.	V. slight.	.10	Faintly vegetable.	Faintly vegetable.	3.30	0.90	.0020	.0126	.0122	.0004	.24	.0000	.0001	.26	1.0
110340	Aug. 19	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	3.55	1.10	.0012	.0130	.0112	.0018	.30	.0000	.0000	.24	1.0
110694	Sept. 2	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.10	0.90	.0020	.0182	.0162	.0020	.26	.0000	.0001	.20	0.8
111240	Sept. 16	None.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.55	1.15	.0020	.0170	.0154	.0016	.31	.0000	.0000	.23	1.3
111818	Oct. 7	None.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.05	0.95	.0024	.0168	.0152	.0016	.30	.0000	.0000	.26	0.6
112158	Oct. 21	V. slight.	V. slight.	.08	Faintly vegetable.	Distinctly vegetable.	2.85	1.00	.0012	.0114	.0102	.0012	.31	.0000	.0000	.24	1.1
112533	Nov. 6	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.00	1.00	.0016	.0158	.0118	.0040	.36	.0020	.0000	.23	1.0
112818	Nov. 18	None.	V. slight.	.09	V. faintly vegetable.	Faintly vegetable.	3.20	1.20	.0016	.0106	.0102	.0004	.30	.0010	.0000	.20	0.8
113152	Dec. 2	None.	V. slight.	.11	V. faintly vegetable.	V. faintly vegetable.	3.10	0.80	.0018	.0166	.0124	.0042	.29	.0000	.0000	.23	1.1
113472	Dec. 16	None.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.40	1.05	.0026	.0144	.0118	.0026	.29	.0020	.0000	.18	0.8
Av.	....	....	....	.11	....	....	3.19	1.04	.0021	.0135	.0117	.0018	.30	.0012	.0000	.25	1.1

TABLE No. 29. — *Chemical Examinations of Water from the Sudbury Reservoir.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
105127	Jan. 6	V. slight.	V. slight.	.09	Faintly vegetable.	Faintly vegetable.	3.40	1.55	.0026	.0152	.0128	.0024	.32	.0020	.0000	.24	1.3
105738	Feb. 3	V. slight.	V. slight.	.11	Faintly vegetable.	Faintly vegetable.	3.55	1.05	.0030	.0126	.0088	.0038	.33	.0080	.0000	.24	1.7
106307	Mar. 3	None.	V. slight.	.13	None.	V. faintly vegetable.	3.50	1.40	.0034	.0138	.0112	.0026	.33	.0040	.0000	.21	1.3
106917	Mar. 31	V. slight.	V. slight.	.15	Faintly vegetable.	Distinctly vegetable.	3.65	1.10	.0026	.0128	.0104	.0024	.35	.0100	.0000	.24	1.7
107570	May 5	V. slight.	Slight.	.20	Faintly vegetable.	Distinctly vegetable.	4.35	1.35	.0038	.0180	.0166	.0014	.45	.0160	.0000	.33	1.7
108173	June 2	V. slight.	V. slight.	.18	Faintly vegetable.	Faintly vegetable.	5.10	1.40	.0048	.0192	.0148	.0044	.48	.0040	.0000	.38	1.7
108860	July 30	V. slight.	V. slight.	.17	Distinctly vegetable.	Decidedly vegetable.	4.40	1.15	.0030	.0180	.0170	.0010	.36	.0040	.0001	.32	1.8
109701	Aug. 4	V. slight.	V. slight.	.09	Faintly vegetable and faintly unpleasant.	Distinctly vegetable and faintly unpleasant.	3.50	1.20	.0010	.0158	.0124	.0034	.35	.0000	.0000	.29	1.4
110699	Sept. 2	V. slight.	V. slight.	.15	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.90	1.20	.0012	.0170	.0148	.0022	.35	.0000	.0002	.25	1.4
111760	Oct. 6	V. slight.	V. slight.	.11	Faintly unpleasant.	Distinctly unpleasant.	3.70	1.10	.0026	.0198	.0140	.0058	.29	.0000	.0000	.23	1.8
112418	Nov. 3	None.	V. slight.	.08	V. faintly unpleasant.	Faintly unpleasant.	3.35	1.00	.0022	.0162	.0124	.0038	.28	.0000	.0000	.19	1.1
113122	Dec. 1	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.45	1.00	.0016	.0146	.0110	.0036	.30	.0010	.0000	.25	1.4
Av.	....	....	....	.13	....	....	3.82	1.21	.0025	.0161	.0130	.0031	.35	.0041	.0000	.26	1.4

TABLE No. 30. — *Chemical Examinations of Water from Spot Pond, Stoneham.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
				Platinum Standard.						Total.	Dissolved.	Suspended.					
105114	Jan. 6	V. slight.	V. slight.	.05	Faintly vegetable.	Distinctly vegetable.	3.40	0.90	.0014	.0150	.0120	.0030	.36	.0010	.0000	.24	1.7
106086	Feb. 19	None.	V. slight.	.05	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.00	0.85	.0008	.0132	.0110	.0022	.39	.0010	.0000	.20	1.7
106504	Mar. 12	V. slight.	Slight.	.10	Faintly unpleasant.	Faintly unpleasant.	3.35	1.00	.0012	.0164	.0132	.0032	.41	.0010	.0000	.22	1.3
106983	Apr. 2	V. slight.	Slight.	.09	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.05	1.05	.0020	.0196	.0142	.0054	.36	.0010	.0000	.16	1.3
107568	May 5	V. slight.	Slight.	.08	Faintly vegetable and faintly unpleasant.	Distinctly vegetable and faintly unpleasant.	3.80	1.15	.0010	.0182	.0132	.0050	.39	.0010	.0000	.22	1.3
108151	June 2	V. slight.	V. slight.	.10	Faintly vegetable.	Faintly vegetable.	3.30	1.30	.0016	.0166	.0132	.0034	.40	.0020	.0000	.26	1.7
108970	July 7	V. slight.	V. slight.	.07	V. faintly unpleasant.	Faintly unpleasant.	3.75	1.00	.0024	.0206	.0186	.0020	.33	.0000	.0000	.23	1.3
109693	Aug. 4	V. slight.	V. slight.	.06	V. faintly vegetable.	Faintly vegetable.	3.60	1.35	.0020	.0196	.0164	.0032	.34	.0000	.0000	.26	1.4
110684	Sept. 2	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.75	1.10	.0032	.0194	.0176	.0018	.39	.0000	.0000	.22	1.4
111732	Oct. 6	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable and sweetish.	4.15	1.10	.0008	.0180	.0144	.0036	.37	.0000	.0000	.20	1.3
112416	Nov. 3	V. slight.	V. slight.	.07	V. faintly vegetable.	Faintly vegetable.	3.60	0.90	.0008	.0166	.0126	.0040	.40	.0000	.0000	.19	1.3
113112	Dec. 2	V. slight.	V. slight.	.08	V. faintly vegetable.	Faintly vegetable.	3.40	0.95	.0008	.0168	.0124	.0044	.32	.0000	.0000	.22	1.4
Av.	....	....	....	.08	....	....	3.51	1.05	.0015	.0175	.0141	.0034	.37	.0006	.0000	.22	1.4

TABLE NO. 31. — *Chemical Examinations of Water from Lake Cochituate.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	COLOR. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID. Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
105124	Jan. 6	Slight.	Slight.	.21	Distinctly vegetable and earthy.	Decidedly vegetable and earthy.	6.75	2.50	.0028	.0408	.0178	.0230	.70	.0000	.0000	.38	3.0
105720	Feb. 3	V. slight.	Slight.	.20	Faintly vegetable.	Distinctly vegetable and faintly unpleasant.	6.45	1.80	.0016	.0324	.0144	.0180	.73	.0000	.0000	.32	2.5
106340	Mar. 4	Slight.	Considerable.	.20	V. faintly vegetable.	Faintly vegetable.	6.40	1.75	.0008	.0356	.0166	.0190	.68	.0000	.0000	.39	2.6
106914	Mar. 31	Slight.	Considerable.	.25	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	6.35	1.60	.0016	.0384	.0172	.0212	.71	.0000	.0000	.41	2.5
107627	May 6	Slight.	Considerable.	.25	Faintly unpleasant and marshy.	Distinctly unpleasant and marshy.	7.15	2.20	.0008	.0304	.0176	.0128	.72	.0000	.0000	.42	2.6
108187	June 3	V. slight.	Slight.	.25	Distinctly vegetable.	Decidedly vegetable.	7.40	2.05	.0008	.0360	.0194	.0166	.70	.0000	.0001	.48	3.0
108923	July 2	V. slight.	Slight.	.20	Faintly vegetable and faintly unpleasant.	Distinctly vegetable and faintly unpleasant.	7.70	2.40	.0020	.0336	.0246	.0090	.76	.0000	.0000	.41	2.5
109721	Aug. 4	V. slight.	Slight.	.15	V. faintly vegetable.	Faintly vegetable.	7.00	1.75	.0020	.0238	.0178	.0060	.73	.0000	.0000	.40	2.6
110703	Sept. 2	V. slight.	V. slight.	.20	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	7.10	1.80	.0016	.0304	.0230	.0074	.71	.0000	.0000	.40	2.6
111765	Oct. 6	V. slight.	Slight.	.13	Faintly vegetable and marshy.	Distinctly vegetable and marshy.	7.20	2.80	.0016	.0320	.0234	.0086	.71	.0000	.0000	.38	3.0
112428	Nov. 3	Slight.	Slight.	.19	Faintly vegetable.	Distinctly vegetable and faintly unpleasant.	6.25	1.35	.0100	.0252	.0168	.0084	.67	.0000	.0000	.33	2.8
113117	Dec. 1	V. slight.	V. slight.	.19	Faintly vegetable and unpleasant.	Distinctly vegetable and unpleasant.	6.60	2.40	.0212	.0252	.0170	.0082	.70	.0010	.0000	.38	2.7
Av.	....	....	....	.20	....	....	6.86	2.03	.0039	.0320	.0188	.0132	.71	.0001	.0000	.39	2.7

TABLE No. 32. — *Chemical Examinations of Water from a Tap at the State House, Boston.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
				COLOR.						ALBUMINOID.							
		Turbidity.	Sediment.	Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
105112	Jan. 6	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	2.90	0.85	.0016	.0146	.0124	.0022	.34	.0030	.0000	.24	1.3
105722	Feb. 3	None.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	3.60	1.25	.0012	.0102	.0084	.0018	.34	.0100	.0000	.26	1.7
106302	Mar. 3	V. slight.	V. slight.	.11	Faintly geranium.	Faintly geranium.	4.40	1.15	.0018	.0126	.0100	.0026	.37	.0120	.0000	.24	1.7
106896	Mar. 31	V. slight.	V. slight.	.16	Faintly vegetable.	Distinctly vegetable.	3.65	1.00	.0024	.0144	.0122	.0022	.37	.0080	.0001	.28	1.3
107562	May 5	V. slight.	V. slight.	.17	V. faintly vegetable.	Faintly vegetable.	4.35	1.15	.0020	.0146	.0114	.0032	.41	.0150	.0000	.29	1.7
108149	June 2	V. slight.	V. slight.	.20	V. faintly vegetable.	Faintly vegetable.	4.80	1.20	.0012	.0132	.0112	.0020	.43	.0180	.0000	.32	2.0
108856	June 30	V. slight.	Slight.	.17	Faintly vegetable.	Distinctly vegetable.	5.10	1.40	.0018	.0184	.0152	.0032	.33	.0020	.0001	.30	1.6
109688	Aug. 4	V. slight.	V. slight.	.11	Faintly vegetable.	Faintly vegetable.	3.50	1.20	.0004	.0124	.0110	.0014	.29	.0010	.0000	.25	1.3
110680	Sept. 2	V. slight.	V. slight.	.11	Faintly vegetable.	Distinctly vegetable.	3.50	0.90	.0012	.0148	.0138	.0010	.34	.0010	.0000	.25	1.1
111720	Oct. 6	V. slight.	Slight.	.11	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	4.15	1.20	.0014	.0194	.0146	.0048	.36	.0020	.0000	.22	1.7
112411	Nov. 3	V. slight.	V. slight.	.09	Faintly vegetable.	Faintly fishy.	4.00	1.50	.0006	.0158	.0130	.0028	.35	.0020	.0000	.19	1.0
113096	Dec. 1	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.55	0.95	.0008	.0146	.0110	.0036	.21	.0030	.0000	.26	1.4
Av.	....	....	....	.13	....	....	3.96	1.15	.0014	.0150	.0120	.0026	.35	.0064	.0000	.26	1.5

TABLE No. 33. — *Averages of Examinations of Water from Various Parts of the Metropolitan Water Works in 1913.*

[Parts per 100,000.]

LOCALITY.	Samples collected.	COLOR.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
						ALBUMINOID.							
		Platinum Standard.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
Quinepoxet River, Holden,	Semi-monthly,	.45	4.51	1.49	.0019	.0190	.0156	.0035	.58	.0028	.0001	.55	1.0
Stillwater River, Sterling,	Semi-monthly,	.33	3.67	1.24	.0018	.0149	.0126	.0022	.24	.0011	.0006	.42	1.0
Wachusett Reservoir, West Boylston,[1]	Semi-monthly,	.27	3.57	1.17	.0019	.0139	.0117	.0025	.31	.0016	.0000	.40	1.0
Wachusett Reservoir, Clinton, surface,	Semi-monthly,	.11	3.19	1.04	.0021	.0135	.0117	.0018	.30	.0012	.0000	.25	1.1
Wachusett Reservoir, Clinton, bottom,	Semi-monthly,	.11	3.10	1.06	.0024	.0118	.0101	.0022	.29	.0018	.0000	.25	1.0
Marlborough (Walker's Brook),	Monthly,	.72	23.26	5.68	.2905	.0487	.0395	.0092	3.62	.1318	.0085	.86	7.7
Marlborough Brook filter-beds, effluent,[3]	Monthly,	.23	18.12	-	.0619	.0149	-	-	2.21	.3689	.0019	-	6.3
Wachusett Aqueduct, Southborough,	Monthly,	.16	3.50	1.14	.0023	.0141	.0119	.0022	.31	.0038	.0000	.29	1.3
Sudbury Reservoir, surface,	Monthly,	.18	3.82	1.21	.0025	.0161	.0130	.0031	.35	.0041	.0000	.26	1.4
Sudbury Reservoir, bottom,	Monthly,	.13	3.69	1.16	.0033	.0157	.0128	.0029	.33	.0043	.0001	.26	1.4
Framingham Reservoir No. 3, inlet,	Monthly,	.12	3.60	1.15	.0025	.0146	.0124	.0026	.34	.0045	.0000	.24	1.5
Framingham Reservoir No. 3, near dam,	Monthly,	.14	3.77	1.18	.0028	.0167	.0131	.0036	.34	.0032	.0000	.27	1.4
Hopkinton Reservoir, inlet,	Monthly,	1.57	6.98	3.46	.0044	.0415	.0381	.0034	.51	.0010	.0000	1.67	1.8
Hopkinton Reservoir, surface,	Monthly,	.60	4.47	1.79	.0029	.0211	.0185	.0025	.41	.0020	.0000	.71	1.3
Hopkinton Reservoir, bottom,	Monthly,	.56	4.31	1.65	.0032	.0196	.0169	.0029	.40	.0027	.0000	.66	1.3
Ashland Reservoir, inlet,	Monthly,	1.25	5.88	2.72	.0035	.0348	.0310	.0038	.38	.0018	.0001	1.24	1.6
Ashland Reservoir, surface,	Monthly,	.67	4.29	1.78	.0031	.0265	.0223	.0042	.35	.0013	.0001	.77	1.8
Ashland Reservoir, bottom,[3]	Monthly,	.65	4.31	1.71	.0039	.0237	.0211	.0024	.35	.0025	.0001	.72	1.8
Framingham Reservoir No. 2, inlet,	Monthly,	1.03	5.95	2.40	.0052	.0319	.0288	.0031	.46	.0033	.0001	1.07	1.8
Framingham Reservoir No. 2, near dam,	Monthly,	.90	5.51	2.23	.0047	.0278	.0264	.0037	.44	.0036	.0001	.98	1.6
Lake Cochituate, surface,	Monthly,	.20	6.86	2.03	.0039	.0320	.0188	.0132	.71	.0001	.0000	.89	2.7
Lake Cochituate, bottom,	Monthly,	.61	7.38	2.43	.0458	.0397	.0228	.0169	.70	.0001	.0000	.51	2.9
Weston Reservoir,[2]	Monthly,	.12	3.82	1.26	.0024	.0146	.0122	.0023	.35	.0059	.0000	.26	1.5
Terminal chamber, Sudbury Aqueduct,	Monthly,	.15	3.97	1.36	.0019	.0152	.0124	.0027	.34	.0039	.0000	.25	1.4
Spot Pond,	Monthly,	.08	3.51	1.05	.0015	.0175	.0141	.0034	.37	.0006	.0000	.22	1.4
Tap in Revere,	Monthly,	.09	3.73	1.10	.0016	.0147	.0127	.0021	.37	.0009	.0000	.22	1.5
Tap at State House,	Monthly,	.13	3.96	1.15	.0014	.0150	.0120	.0026	.35	.0064	.0000	.26	1.5
Tap in Quincy,	Monthly,	.11	3.81	1.15	.0014	.0122	.0113	.0009	.36	.0079	.0000	.24	1.6

[1] Average of 23 samples.

[2] Average of 9 samples.

[3] Average of 11 samples.

TABLE No. 34. — *Chemical Examinations of Water from a Faucet in Boston, from 1892 to 1913.*

[Parts per 100,000.]

Year.	Color.		Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
						Albuminoid.							
	Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1892, . .	.37	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	–	1.9
1893, . .	.61	.53	4.54	1.84	.0010	.0174	.0147	.0027	.33	.0143	.0001	.60	1.8
1894, . .	.69	.58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
1895, . .	.72	.59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
1896, . .	.49	.45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.0155	.0001	.56	1.4
1897, . .	.65	.55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
1898, . .	.41	.40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
1899, . .	.23	.28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1
1900, . .	.24	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3
1901, . .	.24	.29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0173	.0001	.42	1.7
1902, . .	.26	.30	3.93	1.56	.0016	.0139	.0119	.0020	.29	.0092	.0000	.40	1.3
1903, . .	.25	.29	3.98	1.50	.0013	.0125	.0110	.0015	.30	.0142	.0001	.39	1.5
1904, . .	–	.23	3.93	1.59	.0023	.0139	.0121	.0018	.34	.0110	.0001	.37	1.5
1905, . .	–	.24	3.86	1.59	.0020	.0145	.0124	.0021	.35	.0083	.0001	.35	1.4
1906, . .	–	.24	3.86	1.39	.0018	.0159	.0134	.0025	.34	.0054	.0001	.36	1.3
1907, . .	–	.22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.0068	.0001	.32	1.3
1908, . .	–	.19	3.50	1.35	.0011	.0115	.0092	.0024	.33	.0092	.0001	.26	1.2
1909, . .	–	.18	3.46	1.43	.0011	.0128	.0103	.0025	.28	.0034	.0000	.25	1.3
1910, . .	–	.14	3.05	1.24	.0013	.0118	.0102	.0016	.28	.0030	.0000	.22	1.1
1911, . .	–	.25	4.18	1.66	.0015	.0156	.0128	.0029	.38	.0029	.0000	.33	1.4
1912, . .	–	.17	3.86	1.23	.0018	.0154	.0119	.0034	.36	.0062	.0000	.29	1.7
1913, . .	–	.13	3.96	1.15	.0014	.0150	.0120	.0026	.35	.0064	.0000	.26	1.5

TABLE NO. 35. — *Microscopic Organisms in Water from Various Parts of the Metropolitan Water Works, from 1898 to 1913, inclusive.*

[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WACHUSETT RESERVOIR.		SUDBURY RESERVOIR.		LAKE COCHITUATE.		FRAMINGHAM RESERVOIR. No. 3.	FRAMINGHAM RESERVOIR. No. 2.	ASHLAND RESERVOIR.	HOPKINTON RESERVOIR.	WHITEHALL RESERVOIR.
	Surface.	Bottom.	Surface.	Bottom.	Surface.	Bottom.	Surface.	Mid-depth.	Surface.	Surface.	Surface.
1898,	-	-	354	149	830	696	390	245	263	944	690
1899,	-	-	470	252	905	644	440	218	357	715	303
1900,	-	-	498	361	1,758	1,071	645	365	300	990	437
1901,	-	-	337	225	992	702	336	149	344	480	750
1902,	-	-	590	402	1,071	730	627	204	550	588	188
1903,	-	-	549	388	931	795	459	169	323	231	897
1904,	313	-	517	376	663	542	475	174	183	106	875
1905,	769	592	644	502	1,255	503	535	158	289	840	147
1906,	446	272	953	714	1,407	1,143	692	236	431	475	1,979
1907,	425	212	513	419	1,123	1,200	413	205	378	336	901
1908,	731	466	850	885	1,559	1,241	932	725	699	510	708
1909,	2,151	1,937	2,474	2,513	1,142	1,198	2,372	610	603	294	445
1910,	480	328	464	556	928	1,033	455	430	420	887	154
1911,	649	368	990	988	1,942	2,216	1,140	378	592	457	807
1912,	585	368	939	882	4,682	7,873	888	241	665	510	800
1913,	449	270	553	541	4,964	7,322	560	253	414	208	484

See note at end of this table.

TABLE No. 35. — *Microscopic Organisms in Water, etc.* — Concluded.

[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WESTON RESERVOIR.	SPOT POND.	CHESTNUT HILL RESERVOIR.			TAPS.			
			SUDBURY AQUEDUCT.	COCHITUATE AQUEDUCT.	EFFLUENT GATE-HOUSE.	Southern Low Service.	Southern High Service.	Northern Low Service.	Northern High Service.
	Surface.	Surface.	Inlet.	Inlet.	No. 2.				
1898,	-	485	304	544	304	230	-	-	-
1899,	-	1,129	359	992	329	192	201	-	-
1900,	-	573	568	1,139	897	468	452	-	-
1901,	-	628	344	697	413	243	280	-	-
1902,	-	581	563	937	525	367	451	-	-
1903,	-	650	450	860	435	286	398	-	-
1904,	-	465	405	838	472	303	470	274	180
1905,	-	609	551	904	554	528	671	303	388
1906,	783	671	631	1,042	721	550	583	326	422
1907,	443	590	349	909	419	312	427	205	422
1908,	979	741	783	1,073	689	666	695	443	481
1909,	2,399	1,079	1,999	632	1,899	1,013	1,059	1,313	677
1910,	625	622	457	-	465	447	421	221	374
1911,	934	748	700	1,382	954	778	735	349	461
1912,	1,117	716	855	3,887	919	1,035	967	412	462
1913,	565	607	535	2,622	850	531	410	237	356

NOTE. — A large growth of Asterionella originated in the Wachusett Reservoir in 1909, causing the large number of organisms in the water of Sudbury Reservoir and Framingham Reservoir No. 3, Weston and Chestnut Hill reservoirs, Spot Pond and in the water drawn from taps.

TABLE No. 36. — *Number of Bacteria per Cubic Centimeter in Water from Various Parts of the Metropolitan Water Works, from 1898 to 1913, inclusive.*

[Averages of weekly determinations.]

YEAR.	CHESTNUT HILL RESERVOIR.			SOUTHERN SERVICE TAPS.	
	Sudbury Aqueduct Terminal Chamber.	Cochituate Aqueduct.	Effluent Gate-house No. 2.	Low Service, 185 Boylston Street.	High Service, 1 Ashburton Place.
1898,	207	145	111	96	–
1899,	224	104	217	117	123
1900,	248	113	256	188	181
1901,	225	149	169	162	168
1902,	203	168	121	164	246
1903,	76	120	96	126	243
1904,	347	172	220	176	355
1905,	495	396	489	231	442
1906,	231	145	246	154	261
1907,	147	246	118	130	176
1908,	162	138	137	136	148
1909,	198	229	119	150	195
1910,	216	–	180	178	213
1911,	205	204	151	175	197
1912,	429	450	227	249	259
1913,	123	243	157	119	140
Averages,	234	201	188	159	223

TABLE No. 37. — *Colors of Water from Various Parts of the Metropolitan Water Works in 1913. (Averages of Weekly Determinations.)*

[Platinum Standard.]

MONTH.	WACHUSETT RESERVOIR.						SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR.		LAKE COCHITUATE.			
											No. 2.	No. 3.				
	Surface.	Mid-depth.	Bottom.	Worcester Street Bridge.	Quinepoxet River.	Stillwater River.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Mid-depth.	Mid-depth.	Surface.	Mid-depth.	Bottom.	Influent Streams.[1]
January,	.12	.12	.14	.42	.47	.38	.14	.14	.14	.14	.68	.15	.21	.23	.23	.39
February,	.15	.15	.15	.29	.37	.31	.16	.16	.16	.16	.58	.16	.21	.21	.22	.41
March,	.15	.15	.15	.33	.36	.31	.16	.16	.16	.17	.55	.16	.21	.22	.28	.42
April,	.16	.16	.16	.39	.44	.38	.18	.18	.18	.64	.62	.18	.25	.24	.24	.47
May,	.16	.16	.16	.33	.43	.41	.19	.19	.19	.24	.82	.19	.23	.23	.30	.46
June,	.15	.15	.16	.30	.39	.37	.18	.18	.18	.17	.91	.19	.20	.19	.35	.47
July,	.14	.14	.15	.17	.26	.20	.16	.16	.16	.15	.77	.16	.18	.19	.87	.37
August,	.13	.13	.14	.15	.25	.18	.14	.14	.15	.14	.76	.14	.17	.23	1.74	.40
September,	.12	.13	.14	.14	.39	.32	.14	.14	.14	.14	.68	.14	.19	.25	2.04	.38
October,	.10	.10	.11	.15	.60	.42	.12	.13	.13	.16	.65	.13	.18	.19	1.56	.33
November,	.12	.13	.13	.17	.62	.41	.14	.14	.15	.16	1.52	.15	.21	.22	.67	.38
December,	.08	.08	.08	.34	.46	.35	.14	.14	.14	.14	.83	.14	.19	.20	.21	.39
Averages,	.13	.13	.14	.27	.42	.34	.15	.16	.16	.20	.78	.16	.20	.22	.73	.41

[1] The colors given in this column represent the combined colors of the waters of the four principal feeders. The color of each is determined monthly, and due weight is given in combining the results to the sizes of the streams.

TABLE No. 37. — *Colors of Water, etc.* — Concluded.

[Platinum Standard.]

MONTH.	CHESTNUT HILL RESERVOIR.			SPOT POND.	FELLS RESERVOIR.	NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.	Mid-depth.	Effluent Gate-house.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 185 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January,	.14	-	.13	.09	.09	.15	.10	.14	.14
February,	.16	-	.16	.12	.12	.16	.12	.16	.16
March,	.17	.22	.17	.13	.13	.17	.13	.16	.17
April,	.18	-	.18	.13	.13	.17	.13	.17	.18
May,	.19	-	.18	.13	.13	.17	.13	.18	.18
June,	.19	-	.18	.12	.12	.17	.13	.18	.18
July,	.16	-	.17	.12	.12	.16	.12	.16	.17
August,	.14	.17	.14	.13	.12	.14	.12	.14	.14
September,	.14	.18	.15	.12	.12	.14	.12	.14	.15
October,	.13	-	.13	.12	.11	.13	.11	.13	.13
November,	.15	-	.15	.12	.12	.15	.12	.14	.15
December,	.14	-	.13	.07	.07	.13	.08	.13	.13
Averages,	.16	.19	.16	.12	.12	.15	.12	.15	.16

TABLE No. 38. — *Temperatures of Water from Various Parts of the Metropolitan Water Works in 1913. (Averages of Weekly Determinations.)*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth given for each reservoir is the depth from high-water mark.]

[Degrees Fahrenheit.]

MONTH.	WACHUSETT RESERVOIR (DEPTH AT PLACE OF OBSERVATION 107 FEET).			SUDBURY RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.5 FEET).			WACHUSETT AQUEDUCT.	FRAMINGHAM RESERVOIR NO. 3 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).		
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.
January,	35.6	35.8	36.3	35.1	35.5	36.3	35.7	35.2	35.2	35.2
February,	33.0	33.2	34.2	34.5	35.1	36.0	34.7	36.8	36.8	36.8
March,	37.3	36.0	38.3	38.6	38.8	39.4	37.5	40.9	40.9	40.9
April,	42.6	42.2	41.0	46.9	46.1	45.5	46.8	47.8	47.8	47.8
May,	53.6	49.6	47.3	58.1	56.4	54.6	53.0	58.3	58.3	58.3
June,	63.3	53.6	50.3	67.6	64.0	61.3	58.8	68.1	67.5	66.3
July,	71.3	53.8	51.2	74.1	70.4	68.1	64.1	74.1	73.4	72.4
August,	72.2	62.0	53.5	74.3	71.9	70.8	60.0	73.5	73.3	73.2
September,	67.0	61.2	52.2	66.7	66.9	66.7	61.3	66.5	66.5	66.3
October,	58.4	58.8	52.5	57.6	58.3	58.9	55.5	57.3	57.3	57.3
November,	50.4	49.7	50.2	47.4	48.4	48.8	47.1	46.8	46.8	46.8
December,	40.4	40.6	39.5	38.5	38.8	39.4	39.0	37.6	37.6	37.6
Averages,	52.1	48.0	45.5	53.3	52.6	52.2	49.5	53.6	53.5	53.2

TABLE No. 38. — *Temperatures of Water, etc.* — Concluded.

[Degrees Fahrenheit.]

MONTH.	LAKE COCHITUATE DEPTH AT PLACE OF OBSERVATION 62.5 FEET.			CHESTNUT HILL RESERVOIR.	SPOT POND DEPTH AT PLACE OF OBSERVATION 23.5 FEET.			NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Surface.	Mid-depth.	Bottom.	Effluent (Gatehouse No. 2).	Surface.	Mid-depth.	Bottom.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 186 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January, . .	35.3	37.0	37.0	36.7	36.1	36.0	36.0	41.3	39.0	40.4	45.0
February, .	34.8	35.7	35.7	36.2	34.5	34.8	35.1	40.0	38.4	40.5	41.4
March, . .	40.0	40.0	40.5	40.6	39.0	39.3	39.6	41.0	41.8	43.5	44.7
April, . .	47.0	44.8	45.6	48.8	47.2	46.6	46.9	47.2	40.0	50.1	52.7
May, . .	56.5	49.5	47.3	56.6	55.3	55.3	56.3	56.0	55.8	57.3	59.8
June, . .	68.8	54.3	49.8	66.4	65.5	65.3	65.0	62.8	64.5	65.0	66.4
July, . .	73.4	55.1	49.5	72.3	72.6	72.6	71.6	71.1	72.2	71.6	72.7
August, . .	74.0	56.0	52.0	74.4	73.6	73.5	73.4	73.0	75.0	73.2	74.3
September, .	64.0	56.0	49.5	67.6	67.1	67.1	67.9	66.2	68.8	68.5	69.2
October, . .	57.7	57.5	49.7	59.5	59.4	59.5	59.8	61.8	60.5	60.7	62.0
November, .	48.8	49.0	47.3	49.4	49.5	48.9	49.0	55.0	51.8	52.7	53.6
December, .	39.8	41.0	41.3	38.9	38.9	39.7	40.2	45.8	42.8	45.2	44.3
Averages, .	53.7	48.0	45.5	54.0	53.2	53.2	53.4	55.3	54.9	55.7	57.2

TABLE No. 39. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1913.*

[Degrees Fahrenheit.]

MONTH.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January, ...	62	11	38.0	59	10	37.2	63	8	34.5
February, ...	59	0	26.6	57	—2	26.7	55	—7	23.8
March, ...	72	6	42.9	70	5	42.5	69	5	38.4
April, ...	79	25	48.4	82	23	48.6	83	24	47.1
May, ...	83	36	55.7	84	35	56.5	86	34	55.1
June, ...	91	45	66.8	90	39	66.3	86	41	64.9
July, ...	98	49	73.4	96	48	72.7	89	53	71.1
August, ...	95	44	69.6	96	42	69.2	90	46	67.8
September, ...	87	35	61.5	86	31	60.8	84	34	59.3
October, ...	73	30	55.9	72	29	55.8	71	25	53.9
November, ...	70	24	44.8	69	22	43.5	69	21	43.4
December, ...	59	15	35.8	57	12	34.5	55	9	32.8
Averages, ...	-	-	51.6	-	-	51.2	-	-	49.3

TABLE NO. 40. — *Table showing Length of Main Lines of Water Pipes and Connections owned and operated by Metropolitan Water and Sewerage Board, and Number of Valves set in Same, Dec. 31, 1913.*

	DIAMETER OF PIPES IN INCHES.															Total.
	60	48	42	40	36	30	24	20	16	14	12	10	8	6	4	
Total length owned and operated Dec. 31, 1912 (feet).	29,334[1]	182,696	8,075	-	50,970	27,615	70,253	67,497	67,444	26	26,662	3,768	1,841	945	8	537,134
Gate valves in same,	3	49	-	-	50	28	51	50	74	1	97	18	15	20	-	456
Air valves in same,	25	111	3	-	42	7	36	40	33	-	10	1	-	-	-	308
Acquired from Boston Water Works,[2]	-	28,490	1,108	6,989	10,443	21,606	3,913	3,514	10	-	28	-	-	-	-	76,101
Gate valves in same,	-	4	1	2	5	12	1	1	1	-	2	-	-	-	-	29
Air valves in same,	-	13	-	3	5	10	1	2	-	-	-	-	-	-	-	34
Length laid or relaid during 1913 (feet),	-	11	-	-	-	17	1,555	20	339	-	45	-	39	17	-	2,043
Gate valves in same,	-	-	-	-	-	1	-	-	2	-	2	-	2	2	-	9
Air valves in same,	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	2
Length abandoned during 1913 (feet),	-	11	-	-	-	17	1,564	245	14	-	422	-	20	-	-	2,293
Gate valves in same,	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2
Air valves in same,	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Length owned and operated Dec. 31, 1913 (feet).	29,334[1]	211,186	9,183	6,989	61,413	49,221[3]	74,157	70,786	67,779	26	26,313	3,768	1,860	962	8	612,985[4]
Gate valves in same,	3	53	1	2	55	41	52	50	77	1	100	18	17	22	-	492
Air valves in same,	25	124	3	3	47	18	37	42	33	-	10	1	-	-	-	343

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[1] Includes 2,035 feet of 76-inch concrete-lined pressure tunnel and 363 feet of 76-inch mortar-lined and concrete-covered steel pipe, and 21 feet of 76-inch cast-iron pipe.

[2] Acquired under chapter 694 of the Acts of 1912.

[3] Includes 15,565 feet of 30-inch mortar-lined and covered wrought-iron pipe.

[4] 116.10 miles.

TABLE No. 41. — *Statement of Cast-iron Hydrant, Blow-off and Drain Pipes, owned and operated by Metropolitan Water and Sewerage Board, Dec. 31, 1913.*

	DIAMETER OF PIPES IN INCHES.								Total.
	24	20	16	12	10	8	6	4	
Total length in use Dec. 31, 1912 (feet),	352	293	2,371	4,816	173	351	3,147	1,439	12,942
Valves in same,	-	-	22	87	1	2	76	44	232
Acquired from Boston Water Works (feet),[1]	-	-	445	1,010	-	5	60	-	1,520
Valves in same,	-	-	7	15	-	1	2	-	25
Length laid or relaid in 1913 (feet),	-	-	-	-	-	-	-	-	-
Valves in same,	-	-	-	-	-	-	-	-	-
Length abandoned in 1913 (feet),	-	-	-	-	-	-	8	14	22
Valves in same,	-	-	-	-	-	-	1	1	2
Total length in use Dec. 31, 1913 (feet),	352	293	2,816	5,826	173	356	3,199	1,425	14,440[2]
Valves in same,	-	-	29	102	1	3	77	43	255

[1] Acquired under chapter 694 of the Acts of 1912.

[2] 2.73 miles.

TABLE No. 42. — *Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1913.*

BY WHOM OWNED.	INCHES.																			TOTALS.	
	60	48	42	40	36	30	28	24	20	18	16	14	13	12	10	8	7	6	4	Feet.	Miles.
Metropolitan Water Works,	29,334	211,186	9,183	6,989	61,413	49,221	-	74,157	70,786	-	67,779	26	-	26,313	3,768	1,860	-	962	8	612,985	116.10
Boston,	-	10,637	15,617	15,963	38,260	76,069	244	74,440	91,505	-	236,195	5,021	-	1,348,936	277,515	730,759	-	1,306,984	115,345	4,343,490	822.63
Somerville,	-	-	-	-	-	-	-	-	3,721	367	4,021	7,950	-	84,984	54,487	103,906	-	210,226	20,422	490,084	92.82
Malden,	-	-	-	-	-	-	-	-	-	-	2,706	9,155	-	75,635	29,171	78,540	-	214,479	59,020	468,706	88.77
Chelsea,	-	-	-	-	-	-	-	-	-	-	5,176	-	-	4,974	39,820	28,093	-	139,945	7,005	225,013	42.62
Everett,	-	-	-	-	-	-	-	2,484	2,900	-	5,204	3,524	-	5,570	41,742	23,339	-	141,528	40,600	266,891	50.55
Quincy,	-	-	-	-	-	-	-	-	2,679	-	23,232	-	-	29,125	39,228	117,311	994	331,105	101,727	645,401	122.23
Medford,	-	-	-	-	-	-	-	-	673	-	6,775	9,598	-	27,285	38,557	85,884	-	132,002	29,037	329,811	62.46
Melrose,	-	-	-	-	-	-	-	-	-	-	5,223	2,920	-	22,156	19,846	24,249	-	145,593	52,278	272,265	51.57
Revere,[1]	-	-	-	-	-	-	-	-	-	-	23,265	5,725	975	20,823	22,156	23,971	-	78,915	74,876	250,706	47.48
Watertown,	-	-	-	-	-	-	-	-	-	-	400	11,877	-	5,959	10,172	21,371	-	121,362	12,666	183,807	34.81
Arlington,	-	-	-	-	-	-	-	-	-	-	-	-	-	24,136	28,212	37,349	-	113,076	13,291	216,064	40.92
Milton,	-	-	-	-	-	-	-	-	-	-	103	44	-	22,548	20,935	51,826	-	139,409	17,635	252,500	47.82
Winthrop,	-	-	-	-	-	-	-	-	-	-	-	-	-	4,049	23,941	32,311	-	48,135	56,701	165,137	31.28
Stoneham,	-	-	-	-	-	-	-	-	-	-	-	-	-	5,935	3,315	4,543	-	103,248	17,006	134,047	25.39
Belmont,	-	-	-	-	-	-	-	-	-	-	-	-	-	5,714	16,954	23,460	-	99,034	235	145,397	27.54
Lexington,	-	-	-	-	-	-	-	-	-	-	-	-	-	9,000	4,879	30,643	-	94,681	27,280	166,483	31.53
Nahant,	-	-	-	-	-	-	-	-	-	-	-	4,000	-	150	11,550	4,800	-	36,800	58,883	116,183	22.00
Swampscott,	-	-	-	-	-	-	-	-	-	-	-	-	-	7,390	18,176	7,093	-	66,501	9,025	108,185	20.49
Total feet,	29,334	221,823	24,800	22,952	99,673	125,290	244	151,081	172,264	367	380,079	59,840	975	1,730,682	704,424	1,431,308	994	3,523,985	713,040	9,393,155	-
Total miles,	5.55	42.01	4.70	4.35	18.88	23.73	0.05	28.61	32.63	0.07	71.99	11.33	0.18	327.78	133.41	271.08	0.19	667.42	135.05	-	1,779.01

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[1] Includes small portion of Saugus.

TABLE No. 43. — *Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1913, and the Number of Services and Meters installed during the Year 1913.*

CITY OR TOWN.	Services.	Meters.	Fire Hydrants.	Services Installed.	Meters Installed.
Boston,	100,626	41,654	8,851	1,489	7,488
Somerville,	12,827	7,856	1,175	255	763
Malden,	7,558	7,512	537	114	114
Chelsea,	4,768	4,693	316	86	119
Everett,	5,686	2,290	563	109	369
Quincy,	8,564	7,381	997	396	1,256
Medford,	5,091	5,073	618	301	310
Melrose,	3,784	4,041	348	95	95
Revere,[1]	4,022	1,995	250	248	393
Watertown,	2,417	2,425	353	166	192
Arlington,	2,409	2,438	432	132	481
Milton,	1,678	1,678	388	91	91
Winthrop,	2,740	2,667	254	85	81
Stoneham,	1,544	1,337	149	46	232
Belmont,	1,242	1,242	222	115	115
Lexington,	1,063	843	175	103	92
Nahant,	620	371	94	33	37
Swampscott,	1,702	1,702	165	75	75
Totals,	168,351	97,168	15,887	3,939	12,303

[1] Includes small portion of Saugus.

TABLE NO. 44. — *Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, to which Water rose at Different Stations on the Metropolitan Water Works in 1913.*

1913.	Low Service.														Southern High Service.			
	BOSTON ENGINE HOUSE, BULFINCH STREET.		ALLSTON ENGINE HOUSE, HARVARD STREET.		MEDFORD, MYSTIC RESERVOIR.		MEDFORD CITY HALL ANNEX, HIGH STREET.		SOMERVILLE CITY HALL ANNEX, WALNUT STREET.		MALDEN WATER WORKS SHOP, GREEN STREET.		CHELSEA COURT HOUSE.		BOSTON METROPOLITAN WATER WORKS OFFICE, 1 ASHBURTON PLACE.		WATERTOWN WATER WORKS OFFICE, MAIN STREET.	
MONTH.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January, .	158	137	174	168	166	163	166	160	167	162	166	162	165	158	248	234	264	259
February, .	157	135	178	169	167	164	165	161	167	163	166	163	165	157	249	234	264	259
March, .	159	137	174	167	166	163	166	160	166	162	166	163	166	157	248	229	264	260
April, . .	165	142	174	166	168	165	168	162	166	162	166	162	166	157	249	233	263	259
May, . .	169	139	174	167	168	165	168	163	166	162	166	163	166	157	247	230	262	257
June, . .	164	141	173	168	168	165	168	163	165	162	166	163	166	157	247	229	262	253
July, . .	164	142	177	170	169	166	168	161	167	162	166	163	166	157	247	232	263	252
August, .	165	144	174	168	168	165	168	163	166	162	166	162	166	158	247	233	264	257
September, .	166	145	174	168	167	165	168	163	165	162	165	161	165	156	247	232	263	258
October, .	164	143	173	167	168	165	168	163	167	163	166	161	166	157	248	233	264	258
November, .	164	143	173	167	168	165	168	163	168	163	166	162	166	158	249	233	264	257
December, .	160	136	174	168	167	164	167	163	166	162	165	162	165	157	247	232	264	259
Averages, .	163	140	174	168	168	165	167	162	166	162	166	162	166	157	248	232	263	257

TABLE No. 44. — *Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, etc.* — Concluded.

1913. MONTH.	SOUTHERN HIGH SERVICE — Concluded.								NORTHERN HIGH SERVICE.										NORTHERN EXTRA HIGH SERVICE.	
	BELMONT WATER WORKS SHOP, WAVERLEY STREET.		MILTON WATER WORKS OFFICE, ADAMS STREET.		FORBES HILL TOWER, QUINCY.		QUINCY WATER WORKS SHOP.		SOMERVILLE PUMPING STATION, CEDAR STREET.		MALDEN CITY HALL.		REVERE WATER WORKS OFFICE, BROADWAY.		LYNN ENGINE HOUSE, UNION SQUARE.		WINTHROP TOWN HALL, HERMAN STREET.		LEXINGTON TOWN HALL, MASSACHUSETTS AVENUE.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January, .	263	253	248	235	244	230	237	217	270	252	272	264	269	261	268	258	191	178	431	418
February, .	264	253	247	234	243	228	238	216	269	252	271	264	267	258	265	256	190	178	431	419
March, . .	264	254	250	236	244	228	240	215	270	251	272	264	269	261	268	258	188	177	433	417
April, . .	262	249	251	236	243	229	239	217	270	252	271	264	269	263	269	259	188	175	434	415
May, . .	262	245	248	235	243	228	239	218	269	250	272	263	268	257	267	255	189	174	434	408
June, . .	263	236	249	233	243	224	240	213	268	242	269	261	263	240	258	233	184	166	429	415
July, . .	262	224	251	234	245	224	242	211	268	240	268	260	264	236	254	221	182	162	424	408
August, .	264	225	252	238	245	229	242	214	268	249	268	261	265	245	258	232	184	168	426	411
September, .	263	237	248	235	243	228	241	216	266	249	270	262	267	252	265	250	190	179	426	415
October, .	263	248	249	236	244	230	241	218	267	251	271	264	267	251	267	249	190	178	430	410
November, .	263	249	251	237	245	231	243	220	269	251	271	266	270	259	268	257	192	180	431	417
December, .	264	250	248	235	243	229	240	218	271	253	271	265	268	261	266	258	191	177	430	417
Averages, .	263	244	249	235	244	228	240	216	269	249	271	263	267	254	264	249	188	174	430	415

APPENDIX NO. 3.

WATER WORKS STATISTICS FOR THE YEAR 1913.

The Metropolitan Water Works supply the Metropolitan Water District which includes the following cities and towns: —

CITY OR TOWN.	Population, Census of 1910.	Estimated Population, July 1, 1913.
Boston,	670,585	733,360
Somerville,	77,236	82,810
Malden,	44,404	47,890
Chelsea,	32,452	35,820
Newton,[1]	39,806	42,680
Everett,	33,484	37,300
Quincy,	32,642	35,530
Medford,	23,150	25,650
Hyde Park,	15,507	–[2]
Melrose,	15,715	16,640
Revere,	18,219	20,720
Watertown,	12,875	14,060
Arlington,	11,187	12,550
Milton,	7,924	8,470
Winthrop,	10,132	11,440
Stoneham,	7,090	7,830
Swampscott,	6,204	6,640
Lexington,	4,918	5,400
Belmont,	5,542	6,320
Nahant,	1,184	1,380
Total population of Metropolitan Water District,	1,070,256	1,152,490
Saugus,[3]	280	280

[1] No water supplied during the year from Metropolitan Water Works.

[2] Included in Boston.

[3] Only a small portion of Saugus is supplied with water.

Mode of Supply.

33 per cent. by gravity.
67 per cent. by pumping.

Pumping.

Chestnut Hill Pumping Station No. 1: —

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used: — Bituminous: Beaver Run, Sterling and Sonman. Anthracite: buckwheat. Price per gross ton in bins: bituminous $4 to $4.28, buckwheat $3.04 to $3.09. Average price per gross ton $3.92. Per cent. ashes 10.8.

Chestnut Hill Pumping Station No. 2: —

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used: — Bituminous: Beaver Run, Sterling and Sonman. Anthracite: buckwheat. Price per gross ton in bins: bituminous $3.87 to $3.95, buckwheat $2.89 to $2.91. Average price per gross ton $3.75. Per cent. ashes 11.7.

Spot Pond Station: —

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used: — Bituminous: Georges Creek. Anthracite: screenings. Price per gross ton in bins: bituminous $4.78 to $5.15, screenings $2.50. Average price per gross ton $4.09. Per cent. ashes 12.2.

	CHESTNUT HILL PUMPING STATIONS.			
	No. 1.			No. 2.
	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Engine No. 12.
Daily pumping capacity (gallons),	16,000,000	20,000,000	30,000,000	40,000,000
Coal consumed for year (pounds),	1,212,759	29,525	2,783,226	4,921,045
Cost of pumping, figured on pumping station expenses.	$4,669.64	$153.92	$17,135.93	$17,635.22
Total pumpage for year, corrected for slip (million gallons).	459.35	23.56	3,991.82	7,314.38
Average dynamic head (feet),	133.99	120.15	119.19	122.32
Gallons pumped per pound of coal,	378.76	797.97	1,434.24	1,486.35
Duty on basis of plunger displacement,	43,580,000	83,530,000	145,260,000	154,520,000
Cost per million gallons raised to reservoir,	$10.1658	$6.5331	$4.2328	$2.4110
Cost per million gallons raised one foot,	.0759	.0544	.0360	.0197

	CHESTNUT HILL PUMPING STATION No. 2.	SPOT POND STATION.
	Engines Nos. 5, 6 and 7.	Engines Nos. 8 and 9.
Daily pumping capacity (gallons),	105,000,000	30,000,000
Coal consumed for year (pounds),	5,081,095	2,230,505
Cost of pumping, figured on pumping station expenses,	$28,589.64	$13,968.51
Total pumpage for year, corrected for slip (million gallons),	13,742.46	2,600.88
Average dynamic head (feet),	39.07	127.41
Gallons pumped per pound of coal,	2,704.63	1,166.05
Duty on basis of plunger displacement,	89,830,000	126,270,000
Cost per million gallons raised to reservoir,	$2.0804	$5.3707
Cost per million gallons raised one foot,	.0532	.0422

Consumption.

Estimated total population of the nineteen cities and towns supplied wholly or partially during the year 1913,	1,109,810
Total consumption (gallons), pump basis,	38,170,730,000
Average daily consumption (gallons), pump basis,	104,577,000
Gallons per day to each inhabitant, pump basis,	94

Distribution.

	Owned and operated by Metropolitan Water and Sewerage Board.	Total in District supplied by Metropolitan Water Works.
Kinds of pipe used,	–[1]	–[1]
Sizes,	60–4 inch.	60–4 inch.
Extensions, less length abandoned (miles),	14.37[2]	33.11
Length in use (miles),	116.10	1,779.01
Stop-gates added,	36[2]	-
Stop-gates now in use,	492	-
Service pipes added,	-	3,662
Service pipes now in use,	-	168,300
Meters added,	-	11,696
Meters now in use,	-	97,056
Fire hydrants added,	-	509
Fire hydrants now in use,	-	15,887

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[1] Cast-iron, cement-lined wrought-iron, cement-lined steel and kalamine pipe.

[2] Includes pipes and stop-gates acquired from Boston Water Works under chapter 694 of the Acts of 1912.

APPENDIX No. 4.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1.	2.	3.	AMOUNT OF BID.		6.
	Number of Contract.	WORK.	Number of Bids.	4. Next to Lowest.	5. Lowest.	Contractor.
1	95[1]	425 tons of coal for Alewife Brook pumping station.	2	$4.85 per ton.	$4.60 per ton.[2]	Locke Coal Co., Malden.
2	96[1]	6,600 tons of coal: — 2,600 tons for Deer Island pumping station. 3,000 tons for East Boston pumping station. 1,000 tons for Charlestown pumping station.	 3 3 3	 $4.18 per ton. $4.03 per ton. $4.08 per ton.	 $3.98 per ton.[2] $3.98 per ton.[2] $3.98 per ton.[2]	Metropolitan Coal Co., Boston.
3	99[1]	Section 67, New Mystic Sewer, North Metropolitan System in Medford and Winchester.	7	$104,575 00	$93,090 00[2]	Coleman Bros., Chelsea.
4	100[1]	Extension of screen-house at East Boston pumping station.	9	4,782 00	4,700 00[2]	J. E. Locatelli & Co., Boston.
5	101[1]	Two sets of screens for the East Boston pumping station.	2	7,885 00	5,842 00[2]	New England Structural Co., Boston.
6	102	Reconstruction of part of Section 30, North Metropolitan System in Cambridge.	4	9,195 00	7,805 00[2]	Wm. J. Barry, Boston.
7	103	Section 70, New Mystic sewer, North Metropolitan System in Winchester.	8	39,116 50	37,555 00[2]	Ross and Barbaro, Winchester.
8	104	Section 68, New Mystic sewer, North Metropolitan System in Winchester.	5	77,748 20	67,535 00[2]	G. M. Bryne Co., Boston.

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[1] Contract completed.

APPENDIX No. 4.

THE YEAR 1913 — SEWERAGE WORKS.

North Metropolitan System.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1913.	10. Value of Work done Dec. 31, 1913.	
June 5, 1912	July 1, 1913	- - -	$1,930 57	1
June 5, 1912	July 1, 1913	- - -	26,366 88	2
Oct. 15, 1912	June 4, 1913	- - -	93,638 81	3
Dec. 26, 1912	June 14, 1913	- - -	4,700 00	4
Feb. 1, 1913	Aug. 15, 1913	For furnishing and delivering two sets of screens at the East Boston pumping station in condition for erection.	5,842 00	5
May 1, 1913	Aug. 16, 1913	For earth excavation and refilling in trench for 36-inch concrete sewer and 36-inch brick sewer $4.50 per lin. ft.; for Portland cement brick masonry in manholes and special structures, $14 per cu. yd.; for Portland cement concrete masonry in trench, $9.50 per cu. yd.; for spruce piles in place in trench, $25 per lin. ft.	7,754 56	6
April 9, 1913	-	For earth excavation and refilling in trench for 24-inch x 36-inch concrete sewer, $3.50 per lin. ft.; for Portland cement brick masonry in manholes and special structures, $16 per cu. yd.; for Portland cement concrete in trench, $7.25 per cu. yd.; for spruce piles in place in trench, $0.60 per lin. ft.; for rock excavation in trench, $5 per cu. yd.	23,637 20	7
June 11, 1913	-	For earth excavation and refilling in trench for 54-inch concrete sewer, $7.50 per lin. ft.; for earth excavation and refilling in trench and embankment for 48-inch concrete sewer, $6.50 per lin. ft.; for earth or rock excavation or both in tunnel for 48-inch concrete sewer, $15 per lin. ft.; for earth excavation and refilling in trench for 18-inch, 15-inch, and 12-inch pipe drains, $1.75 per lin. ft.; for Portland cement brick masonry in shafts, manholes, catch-basins, and special structures, $16 per cu. yd.; for Portland cement concrete masonry in trench, retaining wall and special structures, $7.50 per cu. yd.; for Portland cement concrete masonry in tunnel, $9 per cu. yd.; for spruce piles in trench in place, $25 per lin. ft.	64,030 21	8

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[3] Contract based upon this bid.

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
9	105	Section 48A, North Metropolitan System in Somerville and Medford.	8	$2,101 40	$1,876 75[2]	Antony Cefalo, Boston.
10	106	425 tons of coal for Alewife Brook pumping station.	1	-	$5.15 per ton.[2]	Locke Coal Company, Malden.
11	107	6,800 tons of coal: —				Metropolitan Coal Co., Boston.
		2,700 tons for Deer Island pumping station.	1	-	$4.62 per ton.[2]	
		3,000 tons for East Boston pumping station.	1	-	$4.54 per ton.[2]	
		1,100 tons for Charlestown pumping station.	1	-	$4.54 per ton.[2]	

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
1	97[1]	2,700 tons of coal: —				Metropolitan Coal Co., Boston.
		2,200 tons for Ward Street pumping station.	3	$4.40 per ton.	$4.31 per ton.[2]	
		500 tons for Nut Island screen-house.	2	$4.37 per ton.	$4.12 per ton.[2]	
2	98[1]	475 tons of coal for Quincy pumping station.	2	$4.74 per ton.	$4.65 per ton.[2]	City Fuel Co., Boston.
3	108	2,650 tons of coal: —				Metropolitan Coal Co., Boston.
		2,200 tons for Ward Street pumping station.	1	-	$5.15 per ton.[2]	
		450 tons for Nut Island screen-house.	1	-	$4.78 per ton.[2]	
4	109	425 tons of coal for Quincy pumping station.	1	-	$5.10 per ton.[2]	Frost Coal Company, Boston.

[1] Contract completed.

North Metropolitan System — Concluded.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1913.	10. Value of Work done Dec. 31, 1913.	
June 28, 1913	Aug. 23, 1913	For earth excavation and refilling in trench for 15-inch pipe sewer, $1.75 per lin. ft.; for Portland cement brick masonry in manholes, $15.30 per cu. yd.; for Portland cement concrete masonry in trench, $6.30 per cu. yd.	$1,397 53	9
June 23, 1913	–	$5.15 per ton of 2,240 lbs. delivered in bins at Alewife Brook pumping station.	715 21	10
June 23, 1913	–	$4.82 per ton of 2,240 lbs. delivered in bins at Deer Island pumping station. $4.54 per ton of 2,240 lbs. delivered in bins at East Boston pumping station. $4.54 per ton of 2,240 lbs. delivered in bins at Charlestown pumping station.	13,721 30	11

THE YEAR 1913 — SEWERAGE WORKS — *Continued.*

South Metropolitan System.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1913.	10. Value of Work done Dec. 31, 1913.	
June 5, 1912	July 1, 1913	- - -	$11,201 51	1
June 5, 1912	July 1, 1913	- - -	2,146 61	2
June 23, 1913	–	$5.15 per ton of 2,240 lbs. delivered in bins at Ward Street pumping station. $4.78 per ton of 2,240 lbs. delivered on wharf at Nut Island screen-house.	6,298 66	3
June 23, 1913	–	$5.10 per ton of 2,240 lbs. delivered in bins at Quincy pumping station.	290 17	4

[2] Contract based upon this bid.

CONTRACTS MADE AND PENDING DURING THE YEAR 1913 — SEWERAGE WORKS — *Concluded.*

Summary of Contracts.

	Value of Work done Dec. 31, 1913.
North Metropolitan System, 11 contracts,	**$243,734 77**
South Metropolitan System, 4 contracts,	**19,945 95**
Total of 15 contracts made and pending during the year 1913,	**$263,680 72**

APPENDIX No. 5.

FINANCIAL STATEMENT PRESENTED TO THE GENERAL COURT ON JANUARY 19, 1914.

The Metropolitan Water and Sewerage Board respectfully presents the following abstract of the account of its doings, receipts, expenditures, disbursements, assets and liabilities for the year ending November 30, 1913, in accordance with the provisions of chapter 235 of the Acts of the year 1906.

METROPOLITAN WATER WORKS.

Construction.

The loans authorized for expenditures under the Metropolitan Water acts, the receipts which are added to the loan fund, the expenditures for the construction and acquisition of works, and the balance available on December 1, 1913, have been as follows: —

Loans authorized under Metropolitan Water acts, . . .		$42,798,000 00
Receipt from town of Swampscott for admission to Metropolitan Water District, paid into Loan Fund (St. 1909, c. 320), . .		90,000 00
Receipts from the sales of property which are placed to the credit of the Metropolitan Water Loan Fund: —		
For the year ending November 30, 1913, .	$4,622 46	
For the period prior to December 1, 1912, .	220,836 14	
		225,458 60
		$43,113,458 60
Amount approved for payment by the Board out of the Metropolitan Water Loan Fund: —		
For the year ending November 30, 1913, .	$206,551 87	
For the period prior to December 1, 1912, .	42,029,922 65	
		42,236,474 52
Balance, December 1, 1913, ...		$876,984 08

The amount of the Metropolitan Water Loan bonds issued at the end of the fiscal year was $41,788,000, no additional bonds having been issued during the year. Of the amount issued, $41,398,000 were sinking fund bonds, and the remainder, amounting to $390,000, were issued as serial bonds.

At the end of the year the amount of the outstanding bonds was $41,773,000, as bonds issued on the serial payment plan to the amount of $15,000 had been paid. During the fiscal year, $10,000 in serial bonds has been paid.

The Metropolitan Water Loan sinking fund amounted on December 1, 1913, to $10,765,512.65, an increase during the year of $954,331.36.

The net debt on December 1, 1913, was $31,007,487.35, a decrease during the fiscal year of $964,331.36.

Maintenance.

Amount appropriated for the maintenance and operation of works, for the year ending November 30, 1913,	$447,000 00	
Balance of special appropriation for the improvement of the Cochituate watershed (1909–1911) remaining,	1,117 12	
Special appropriation for protection of water supply in aqueducts (1911) remaining,	14,921 21	
Special appropriation for protection and improvement of the water supply (1912),	20,000 00	
Receipts credited to this fund for year ending November 30, 1913,	45,406 63	
		$528,444 96
Amount approved by Board for maintenance and operation of works during year ending November 30, 1913,		426,705 40
Balance, December 1, 1913,		$101,739 56

This balance includes the sum of $14,921.21, the amount remaining unexpended of the special appropriation for the protection of the water supply in aqueducts, and the sums of $17,497.11, the amount remaining unexpended of the special appropriation in 1912, and $20,000, the special appropriation in 1913 for the protection and improvement of the water supply.

The Board has also received during the year ending November 30, 1913, $45,406.63 from rentals, the sale of land, land products and power and from other proceeds from the operations of the Board which, according to section 18 of the Metropolitan Water Act, are applied by the Treasurer of the Commonwealth to the payment of interest on the Metropolitan Water Loan, to sinking fund requirements, and expenses of maintenance and operation of works, in reduction of the amount to be assessed upon the Metropolitan Water District for the year.

Sums received from sales of water to municipalities not belonging to the District and to water companies, and from municipalities for admission to the District, have been applied as follows: —

For the period prior to December 1, 1906, distributed to the cities and towns of the District, as provided by section 3 of the Metropolitan Water Act, ...	$219,865 65
For the period beginning December 1, 1906, and prior to December 1, 1912, applied to the Metropolitan Water Loan sinking fund, as provided by chapter 238 of the Acts of 1907, ...	41,601 63
For the year beginning December 1, 1912, and ending November 30, 1913, applied to the Metropolitan Water Loan sinking fund, as provided by said last-named act, ...	4,570 83
	$266,038 11

Metropolitan Sewerage Works.

Construction.

The loans authorized under the various acts of the Legislature for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of the loans, and the expenditures for construction, are given below, as follows: —

North Metropolitan System.

Loans authorized for expenditures for construction under the various acts, including those for the Revere, Belmont and Malden extensions, North System enlargements and extensions, and new Mystic sewer, ...	$7,013,865 73	
Receipts from sales of real estate and from miscellaneous sources, which are placed to the credit of the North Metropolitan System: —		
For the year ending November 30, 1913, .	9,995 08	
For the period prior to December 1, 1912, .	75,184 24	
Amount approved for payment by the Board[1] out of the Metropolitan Sewerage Loan Fund, North System: —		
For the year ending November 30, 1913, .		$218,175 36
For the period prior to December 1, 1912, .		6,726,457 45
	$7,099,045 05	$6,944,632 81
Balance, December 1, 1913, ...		$154,412 24

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[1] The word "Board" refers to the Metropolitan Sewerage Commission and its successor the Metropolitan Water and Sewerage Board.

South Metropolitan System.

Loans authorized for expenditures for construction under the various acts, applied to the construction of the Charles River valley sewer, Neponset valley sewer, High-level sewer and extension,	$8,867,046 27	
Receipts for pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System: —		
For the year ending November 30, 1913,	76 75	
For the period prior to December 1, 1912,	14,004 60	
Amount approved by the Board for payment as follows: —		
On account of the Charles River valley sewer,		$800,046 27
On account of the Neponset valley sewer,		911,531 46
On account of the High-level sewer and extension: —		
For the year ending November 30, 1913,		1,082 63
For the period prior to December 1, 1912,		7,108,911 32
	$8,881,127 62	$8,821,571 68
Balance, December 1, 1913,		$59,555 94

The amount of the Metropolitan Sewerage Loan bonds issued at the end of the fiscal year was $15,880,912, bonds amounting to $378,000 having been issued during the year. Of the amount issued, $15,440,912 were sinking fund bonds, and the remainder, amounting to $440,000, were serial bonds.

At the end of the year the amount of the outstanding bonds was $15,877,912, as bonds issued on the serial payment plan to the amount of $3,000 had been paid during the year.

Of the total amount outstanding at the end of the year, $7,000,000 were issued for the North Metropolitan System and $8,877,912 for the South Metropolitan System. The Metropolitan Sewerage Loan sinking fund amounted on December 1, 1913, to $2,748,182.33, of which $1,755,553.90 was on account of the North Metropolitan System and $992,628.43 was on account of the South Metropolitan System.

The net debt on December 1, 1913, was $13,129,729.67, an increase of $81,007.39.

Included in the above figures for the North Metropolitan System is $62,000 in serial bonds issued under chapter 512 of the Acts of 1911, of which $3,000 has been paid.

Maintenance.

North Metropolitan System.

Appropriated for the year ending November 30, 1913,	$170,600 00
Receipts from pumping and from other sources which are returned to the appropriation: —	
For the year ending November 30, 1913,	604 59
	$171,204 59
Amount approved for payment by the Board: —	
For the year ending November 30, 1913,	162,333 66
Balance, December 1, 1913,	$8,870 93

South Metropolitan System.

Appropriated for the year ending November 30, 1913,	$109,460 00
Receipts from sales of property and for pumping, which are returned to the appropriation: —	
For the year ending November 30, 1913,	189 85
	$109,649 85
Amount approved for payment by the Board: —	
For the year ending November 30, 1913,	100,910 79
Balance, December 1, 1913,	$8,739 06

APPENDIX No. 6.

LEGISLATION OF THE YEAR 1913 AFFECTING THE METROPOLITAN WATER AND SEWERAGE BOARD.

Acts of 1913.

CHAPTER 154.

AN ACT TO AUTHORIZE THE CITY OF QUINCY TO SELL WATER FOR MECHANICAL OR MANUFACTURING USES ON CERTAIN TERMS.

Be it enacted, etc., as follows:

The city of Quincy exempted from paying for water sold for certain purposes.

SECTION 1. The city of Quincy shall not be required to pay, and is hereby exempted from paying, to the treasurer of the commonwealth any money toward the interest, sinking fund requirements, and expenses of maintenance and operation of the metropolitan water system, or on any account whatsoever, for any water from its reservoir in the town of Braintree that it may sell or distribute in any year, exclusively for mechanical or manufacturing uses and purposes, and the water so sold shall not be considered by the metropolitan water and sewerage board in determining the amount of water consumed by said city during said year, which said board is required to certify to the treasurer of the commonwealth under the provisions of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, as amended by chapter four hundred and fifty-seven of the acts of the year nineteen hundred and six, or by any other acts in amendment thereof or in addition thereto; and the city of Quincy is hereby exempted from any provision of any of said acts which may now authorize the treasurer of the commonwealth to assess it on account of water from its own supply which it may so sell or distribute: *provided, however,* that the metropolitan water and sewerage board certifies to the treasurer and receiver general of the commonwealth that the water

Proviso.

sold and distributed under this act has been used for mechanical or manufacturing purposes only.

Provision in contracts for sale of water.

SECTION 2. Any contract which the said city may make with a consumer for the sale of said water for mechanical or manufacturing uses or purposes shall contain a provision that whenever the public authority having control of the water of said reservoir determines that there is occasion to use said water for public purposes, said authority may terminate such contract on giving to the consumer reasonable notice of its intention so to do. Whenever such a contract is so terminated, the consumer shall not be entitled to any compensation by way of damage or otherwise by reason thereof. Such a contract may be entered into in behalf of the city by the mayor and the commissioner of public works, and may be for a year or for a greater or less period of time, as they may think proper, and upon such further terms and conditions as they may determine that the interests of the city require.

Not to affect certain rights.

SECTION 3. This act shall not in any manner abridge any right which the city of Quincy may now have concerning the disposal of said water, and the authority conferred by this act shall be in addition to the authority now possessed by it.

SECTION 4. This act shall take effect upon its passage. [*Approved February 24, 1913.*

CHAPTER 351.

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE SOUTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.

Be it enacted, etc., as follows:

Appropriation for maintenance of south metropolitan sewerage works.

SECTION 1. A sum not exceeding one hundred nine thousand four hundred and sixty dollars is hereby appropriated, to be paid out of the South Metropolitan System Maintenance Fund, for the cost of maintenance and operation of the south metropolitan system of sewage disposal, comprising a part of Boston, the cities of Newton and Waltham, and the towns of Brookline, Watertown, Dedham, and Milton, during the fiscal year ending on the thirtieth day of November, nineteen hundred and thirteen.

SECTION 2. This act shall take effect upon its passage. [*Approved March 26, 1913.*

Chapter 352.

An Act making an appropriation for operating the north metropolitan system of sewage disposal.

Be it enacted, etc., as follows:

Appropriation for maintenance of north metropolitan sewerage works.

Section 1. A sum not exceeding one hundred seventy thousand six hundred dollars is hereby appropriated, to be paid out of the North Metropolitan System Maintenance Fund, for the maintenance and operation of a system of sewage disposal for the cities included in what is known as the north metropolitan system, during the fiscal year ending on the thirtieth day of November, nineteen hundred and thirteen.

Section 2. This act shall take effect upon its passage. [*Approved March 26, 1913.*

Chapter 353.

An Act making an appropriation for operating the metropolitan water system.

Be it enacted, etc., as follows:

Appropriation for maintenance of metropolitan water works.

Section 1. A sum not exceeding four hundred and forty-seven thousand dollars is hereby appropriated, to be paid out of the Metropolitan Water Maintenance Fund, for the maintenance and operation of the metropolitan water system for the cities and towns in what is known as the metropolitan water district, during the fiscal year ending on the thirtieth day of November, nineteen hundred and thirteen.

Section 2. This act shall take effect upon its passage. [*Approved March 26, 1913.*

Chapter 377.

An Act to authorize the metropolitan water and sewerage board to construct an additional branch sewer in the city of Somerville.

Be it enacted, etc., as follows:

Construction of branch sewer in Somerville authorized.

Section 1. The metropolitan water and sewerage board is hereby authorized to construct an additional branch sewer through a part of the city of Somerville, in order to dispose of sewage coming from the city of Medford, and for this purpose the said board is hereby authorized to expend any balance of the proceeds of bonds already issued on account of the Metropolitan Sewerage Loan Fund, for the benefit of the north metropolitan sewerage district, which may be in excess of the amount required for satisfying the purposes for which said bonds were issued.

SECTION 2. This act shall take effect upon its passage. [*Approved March 28, 1913.*

CHAPTER 422.

AN ACT RELATIVE TO ALLOWANCES TO CITIES AND TOWNS IN THE METROPOLITAN WATER DISTRICT FOR WATER FURNISHED FROM THEIR OWN SOURCES.

Be it enacted, etc., as follows:

Allowance for water furnished by cities and towns in metropolitan water district from their own sources.

SECTION 1. Any city or town belonging to the metropolitan water district, established under the provisions of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, which is assessed upon its total valuation, or which shall be admitted to the district under said chapter or any subsequent act of the general court, and which shall agree with the metropolitan water and sewerage board to furnish from its own works a constant and fixed quantity of water of proper quality for a term of five or more years, as a part of its own water supply, such quantity to be not greater than the safe capacity of its sources in a dry year as determined by said board, shall be allowed and credited in its apportionment with such sum for every million gallons furnished in accordance with the agreement so made, as shall be determined in each year by the said board and certified by it to the treasurer of the commonwealth: *provided, however,* that the said sum shall not be less than twenty-four dollars per million gallons and shall not exceed the average cost to the metropolitan water district of water furnished from the metropolitan water supply during the year preceding that in which the assessment is made.

SECTION 2. This act shall take effect upon its passage. [*Approved March 31, 1913.*

Chapter 525.

An Act relative to the rate of interest on damages in the case of real estate taken or injured by the metropolitan park commission or the metropolitan water and sewerage board.

Be it enacted, etc., as follows:

Rate of interest on damages for real estate taken by metropolitan park commission and metropolitan water and sewerage board.

Section 1. In a suit to determine damages for the taking of and injury to real estate taken or injured, after the passage of this act, by the metropolitan park commission or by the metropolitan water and sewerage board under authority of any law or statute, the damages so determined shall bear interest at the rate of five per cent per annum from the date when damages are to be assessed under the law or statute by virtue of which such real estate was taken or injured.

Section 2. This act shall take effect upon its passage. [*Approved April 21, 1913.*

Chapter 534.

An Act relative to the preparation and printing of lists of state officials and employees with their salaries or compensation.

Be it enacted, etc., as follows:

1910, 268, § 1, etc., amended.

Section 1. Section one of chapter two hundred and sixty-eight of the acts of the year nineteen hundred and ten, as amended by chapter forty-three of the acts of the year nineteen hundred and eleven, is hereby further amended by striking out after the word "amount", in the sixteenth line, the words "of all money paid for services or salaries to any official or employee, not otherwise", and inserting in place thereof the words: — of money paid for services or salaries to officials or employees not employed on the first day of July preceding and therefore not, — and by striking out all after the word "year", in the next to the last line, and inserting in place thereof the words: — and for the two preceding years, — so as to read as follows: — *Section 1.* Every department, commission, bureau or board of the commonwealth, shall, on or before the fifteenth day of July in the year nineteen

List of officials and employees to be furnished to governor and council, etc.

hundred and ten, and on or before the fifteenth day of July in every year thereafter, prepare and furnish to the governor and council lists of all the officials and employees of the commonwealth employed in or by such department, commission, bureau or board on the first day of July preceding, for whose services money has been paid from the treasury of the commonwealth. The said lists shall be arranged by divisions of the several departments, commissions, bureaus or boards, when such divisions exist, and shall give the name, residence, designation, rate of compensation and the date of election or appointment of every such official and employee, and any increase in the rate of salary or compensation for the year preceding; and also the aggregate amount of money paid for services or salaries to officials or employees not employed on the first day of July preceding and therefore not shown upon the list, for the year beginning with the first day of July in the year preceding that in which the list is prepared. It shall be the duty of the auditor of the commonwealth to verify the said lists, the compensation and the said aggregate amounts from the pay roll. The said lists and aggregate amounts shall be printed at the expense of the commonwealth as a document of the commonwealth, before the first day of October in the year in which they are furnished, and the said document shall contain a summary by departments, commissions, bureaus and boards of the total number of officials and employees employed in or by every such department, commission, bureau and board and the total amount paid for services by every such department, commission, bureau and board from the treasury of the commonwealth, and, respectively, the whole number of such officials and employees, and the whole amount paid for services in a grand total; and a summary by every such department, commission, bureau and board of the total number of such officials and employees and the total amount paid for services for the year and for the two preceding years.

Auditor to verify lists.

To be printed as public document, etc.

SECTION 2. This act shall take effect upon its passage. [*Approved April 22, 1913.*

CHAPTER 537.

AN ACT TO AUTHORIZE THE TOWN OF ARLINGTON TO SELL WATER FOR MECHANICAL AND AGRICULTURAL PURPOSES.

Be it enacted, etc., as follows:

Town of Arlington exempted from paying for water sold by it for certain purposes.

SECTION 1. The town of Arlington shall not be required to pay, and is hereby exempted from paying, to the treasurer of the commonwealth any money toward the interest, sinking fund requirements and expenses of maintenance and operation of the metropolitan water system, or on any account whatsoever, for any water from its reservoir in the towns of Arlington and Lexington which it may sell or distribute in any year exclusively for mechanical, manufacturing or agricultural purposes, and the water so sold shall not be considered by the metropolitan water and sewerage board in determining the amount of water consumed by said town during said year, which said board is required to certify to the treasurer of the commonwealth under the provisions of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, as amended by chapter four hundred and fifty-seven of the acts of the year nineteen hundred and six, or by any other acts in amendment thereof or in addition thereto, and the town of Arlington is hereby exempted from any provision of either of said acts which authorizes the treasurer of the commonwealth to assess it on account of water from its own supply which it may so sell or distribute: *provided, however,* that the metropolitan water and sewerage board certifies to the treasurer and receiver general of the commonwealth that the water sold and distributed under authority of this act has been used for mechanical, manufacturing or agricultural purposes only.

Proviso.

Provision in contracts for sale of water.

SECTION 2. Any contract which the said town may make with a consumer for the sale of water from said reservoir for mechanical, manufacturing or agricultural purposes, shall contain a provision that whenever the public authority having control of the water of said reservoir determines that there is occasion to use said water for public purposes, said authority may terminate such contract on giving to the consumer reasonable notice of its intention so to do. Whenever such a contract is so terminated, the consumer shall not be entitled to any compensation by way of damage or otherwise by reason thereof. Such a contract may be entered into in behalf of the town by the board of public works, and may be for a year or for a greater or less period of time, as the board may think proper, and upon such further terms and conditions as it may determine that the interests of the town require.

Not to affect certain rights of the town.

SECTION 3. This act shall not abridge any right which the town of Arlington may have concerning the disposal of said water, and the authority conferred by this act shall be in addition to the authority now possessed by the town.

SECTION 4. This act shall take effect upon its passage. [*Approved April 23, 1913.*

CHAPTER 558.

AN ACT RELATIVE TO THE DRAINAGE OF MEDFORD STREET IN THE CITY OF SOMERVILLE.

Be it enacted, etc., as follows:

Drainage of Medford street in the city of Somerville.

SECTION 1. In the abolition of the railroad grade crossing at Medford street in Somerville now being made under a decree of the superior court, there shall be provided as a part of the work of construction such method for removing all surface and storm water from the new low grade of the street into the drainage system of the city of Somerville as may be approved by the metropolitan water and sewerage board, instead of the connection with the metropolitan sewerage system as required by the decree, and the expense shall be treated as one of the expenses of the abolition of the crossing.

SECTION 2. This act shall take effect upon its passage. [*Approved April 26, 1913.*

CHAPTER 685.

AN ACT RELATIVE TO WAGES OF EMPLOYEES OF THE METROPOLITAN PARK COMMISSION AND OF THE METROPOLITAN WATER AND SEWERAGE BOARD.

Be it enacted, etc., as follows:

1911, 541, § 1, amended.

SECTION 1. Section one of chapter five hundred and forty-one of the acts of the year nineteen hundred and eleven is hereby amended by striking out the word "twenty-five", in the fourth line, and inserting in place thereof the word: — fifty, — so as to read as follows: — *Section 1.* The wages paid by the metropolitan park commission and by the metropolitan water and sewerage board to laborers directly employed by them shall be not less than two dollars and fifty cents a day.

Wages of certain employees established.

SECTION 2. This act shall take effect upon its passage.

(This bill, returned by the governor to the senate, the branch in which it originated, with his objections thereto, was passed by the senate, May 15, and, in concurrence, by the house of representatives, May 19, the objections of the governor notwithstanding, in the manner prescribed by the Constitution; and thereby has the "force of a law".)

CHAPTER 755.

AN ACT TO AUTHORIZE THE LOWERING OF THE METROPOLITAN WATER MAINS IN CHELSEA CREEK.

Be it enacted, etc., as follows:

Lowering of metropolitan water mains in Chelsea creek authorized.

SECTION 1. The metropolitan water and sewerage board is hereby authorized to lower the metropolitan water mains in Chelsea creek to a sufficient depth to permit the carrying out of the improvements in said creek provided for by an act of the congress of the United States passed in the year nineteen hundred and twelve, and may sink shafts, construct a tunnel and do any other act or thing necessary to comply with the requirements of said act.

Issue of bonds authorized.

SECTION 2. To meet the expenditures incurred under the provisions of this act the treasurer and receiver general shall issue from time to time, upon the request of said board, bonds in the name and behalf of the commonwealth, to be designated on the face thereof, Metropolitan Water Loan, to an amount not exceeding seventy-five thousand dollars in addition to the amount of such bonds heretofore authorized under the provisions of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five and acts in amendment thereof and in addition thereto, and the provisions of said chapter four hundred and eighty-eight and of said acts shall apply to the additional loan.

SECTION 3. This act shall take effect upon its passage.

[illegible]

CHAPTER 769.

AN ACT TO AUTHORIZE THE CITY OF NEWTON TO PROVIDE FOR THE DISPOSAL OF SEWAGE FROM THE RIVERSIDE RECREATION GROUNDS.

Be it enacted, etc., as follows:

Disposal of sewage from Riverside recreation grounds.

SECTION 1. The city of Newton may permit the entrance into the sewers of that city of the sewage of the Riverside Recreation Grounds, so called, situated on the westerly side of Charles river in the town of Weston, so long as the said grounds shall be occupied by the trustees of the Riverside Recreation Grounds, or their successors, upon such terms, agreements and stipulations as may be agreed upon by said city and said trustees, and all sewage so received may be discharged into the south metropolitan sewerage system: *provided, however,* that such terms, agreements and stipulations shall have been approved by the metropolitan water and sewerage board, and that such further provisions as the said board shall deem necessary have been complied with.

Proviso.

SECTION 2. This act shall take effect upon its passage. [*Approved June 13, 1913.*

CHAPTER 814.

AN ACT TO PROVIDE FOR THE IMPROVEMENT OF BEAVER DAM BROOK IN THE TOWNS OF ASHLAND, FRAMINGHAM, SHERBORN AND NATICK.

Be it enacted, etc., as follows:

Improvement of Beaver Dam brook authorized.

SECTION 1. The metropolitan water and sewerage board is authorized to widen, straighten and deepen the channel of Beaver Dam brook in the towns of Ashland, Framingham, Sherborn and Natick, and otherwise to improve said brook from Waushakum pond in the towns of Ashland and Framingham to the outlet of said brook at Lake Cochituate in the town of Natick.

Description of lands, etc., taken to be recorded.

SECTION 2. The said board, for the purposes aforesaid, may take, or acquire by purchase or otherwise, lands, easements, rights of way, water rights and other property, and shall sign and cause to be recorded in the registry of deeds for the county and district in which the property to be taken is situated a description thereof as certain as is required in a common conveyance of land, and stating that the same is taken for the metropolitan water works; and upon such recording the property so described shall vest in the commonwealth.

Damages. SECTION 3. Any person whose property is injured by the taking or by the widening, straightening or deepening of said brook, or by any other act of the said board under the provisions of this act, and who has not released to the commonwealth all claims for damages on account of the same, may have his damages determined by the award of, or by agreement with, the said board; and if the parties cannot agree upon the damages, the damages may be determined by a jury of the superior court for the county of Middlesex under the provisions of chapter forty-eight of the Revised Laws, so far as they may be applicable, upon a petition therefor filed by the person aggrieved in the office of the clerk within one year after the damage is sustained, and the petitioner shall have judgment for the amount determined, with interest on the excess of the amount over the award of the board, and costs if the amount is greater than the award of the said board; otherwise the petitioner shall recover no interest and shall pay costs.

Issue of bonds authorized. SECTION 4. The expense incurred in carrying out the provisions of this act shall be paid out of the treasury of the commonwealth, and the treasurer and receiver general shall, from time to time, on the request of the said board, issue negotiable bonds in the name and in behalf of the commonwealth and under its seal, designated on the face thereof, Metropolitan Water Loan, to an amount not exceeding thirty-three thousand dollars; and the provisions of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five and acts in amendment thereof and in addition thereto shall, so far as the same are applicable, apply to said loan.

Assessment of betterments, etc. SECTION 5. The metropolitan water and sewerage board shall, within one year after the completion of the work hereby authorized, if in its opinion any land receives a benefit from the improvements beyond the general benefit to all land in said towns, and if the owner has not released to the commonwealth all claims for damages on account of any act or thing done by said board, its agents, or servants in carrying out the provisions of this act, determine the value of and assess upon the land receiving such benefit a proportional share of the cost of the said improvements, not exceeding the value of the benefit; and any person whose land is so assessed may have the amount of the assessment determined by a jury of the superior court for the county of Middlesex, under the provisions of chapter fifty of the Revised Laws, so far as they may be applicable, but without interest or costs if the assessment by the jury is less than the amount determined by the said board. The assessment so determined by the said board or by a jury, as the case may be, shall constitute a lien upon the land until it is paid. Every such assessment shall be certified by the secretary of said board or by the clerk of said court to the collector of the town in which the land lies, and shall be collected by him in the manner provided for the collection of taxes, and the proceeds thereof shall be paid into the treasury of the commonwealth and be applied by the treasurer toward payment of the expense incurred in making the said improvements.

Buildings near brook may be connected with sewers of town of Framingham.

SECTION 6. The town of Framingham shall permit dwelling houses and other buildings situated near said brook in the towns of Ashland, Natick or Sherborn, to be connected with the sewers of the town of Framingham, upon payment of such entrance fees as the town of Framingham may determine, and subject to such reasonable regulations and sewer rentals relative thereto as may be adopted and established by the town of Framingham.

Expense to be shared by town of Framingham.

SECTION 7. One third of the expense incurred as aforesaid shall be borne and paid by the town of Framingham, and the said town shall from time to time pay into the treasury of the commonwealth, within three months after notice from the treasurer of the commonwealth, such sums as may be necessary to reimburse the commonwealth for its share of the expense incurred as aforesaid, and the sum so paid by the town shall be applied by the treasurer toward the payment of the said expense.

Town of Framingham Beaver Dam Brook Loan, Act of 1918.

SECTION 8. The town of Framingham may appropriate money for the purpose of paying the amount to be paid by said town into the treasury of the commonwealth under the provisions of this act, and for that purpose the town is hereby authorized, from time to time, to borrow money beyond its statutory limit of indebtedness to an amount not exceeding twelve thousand dollars, and to issue notes or bonds therefor. Such notes or bonds shall bear on the face thereof the words, Town of Framingham Beaver Dam Brook Loan, Act of 1913, and also the words, Exempt from Taxation in Massachusetts, shall be payable by such annual payments beginning not more than one year after the date thereof as will extinguish each loan within twelve years from its date; and the amount of such annual payment of any loan in any year shall not be less than the amount of the principal of such loan payable in any subsequent year. Each authorized issue of notes or bonds shall constitute a separate loan. Said notes or bonds shall bear interest, payable semi-annually, at a rate not exceeding five per cent per annum, and shall be signed by the treasurer and countersigned by the selectmen of the town. The town may sell the said securities at public or private sale, upon such terms and conditions as it may deem expedient, but they shall not be sold for less than their par value.

Payment of loan.

SECTION 9. The town shall, at the time of authorizing the said loan, provide for the payment thereof in accordance with the provisions of the preceding section; and when a vote to that effect has been passed the amount required thereby shall, without further vote, be assessed by the assessors of the town annually thereafter, in the same manner in which other taxes are assessed, until the debt incurred by the loan is extinguished. The said town shall also raise annually by taxation a sum which will be sufficient to pay the interest as it accrues on the notes or bonds issued under authority of this act.

SECTION 10. This act shall take effect upon its passage. [*Approved June 16, 1913.*

CHAPTER 83.

RESOLVE TO PROVIDE FOR AN EXAMINATION RELATIVE TO THE DISPOSAL OF SEWAGE IN THE SOUTH METROPOLITAN SEWERAGE DISTRICT AND TO THE EXTENSION OF SAID DISTRICT.

Examination relative to disposal of sewage for the south metropolitan district.

Resolved, That the state board of health is hereby authorized and directed to re-examine the general subject of the disposal of sewage for the south metropolitan sewerage district, and particularly to consider whether any extension of said district is desirable, and to make report thereon to the general court. For this purpose said board may employ such engineering and other assistants as may be necessary to carry out the purposes of this resolve. All bills for expenses incurred under the provisions of this resolve shall be approved by the governor and council before they are sent to the auditor for payment, and in no event shall the expense exceed the sum of twenty-five hundred dollars. The report herein required shall be made to the general court on or before the fifteenth day of January in the year nineteen hundred and fourteen. [*Approved May 8, 1913.*

CHAPTER 100.

RESOLVE TO PROVIDE FOR AN INVESTIGATION AND A REPORT ON THE IMPROVEMENT OF SPOT POND BROOK IN STONEHAM, MELROSE AND MALDEN.

Spot Pond Brook Improvement Commission, duties, etc.

Resolved, That the chairman of the metropolitan water and sewerage board, the chairman of the metropolitan park commission, the chairman of the county commissioners of the county of Middlesex, the mayor of the city of Malden and the mayor of the city of Melrose are hereby constituted a commission, to be known as the Spot Pond Brook Improvement Commission. The said commission shall investigate the condition of Spot Pond brook in Stoneham, Melrose and Malden and report to the general court, before the tenth day of January, nineteen hundred and fourteen, a plan for the most economical means of preventing flooding along the course of said brook, together with such suggestions and recommendations relative to the improvement of the brook and the drainage of the territory through which it flows as the commission may deem advisable. [*Approved May 29, 1913.*

INDEX TO LEGISLATION OF THE YEAR 1913

AFFECTING THE

METROPOLITAN WATER AND SEWERAGE BOARD.

	Chap.	Sect.
A.		
APPROPRIATIONS.		
for improvement of Beaver Dam Brook,	814	4
for lowering Metropolitan Water mains in Chelsea Creek,	755	2
for maintenance of Metropolitan Water System,	353	1
for maintenance of North Metropolitan Sewerage System,	352	1
for maintenance of South Metropolitan Sewerage System,	351	1
ARLINGTON.		
town of, may sell water for mechanical and agricultural purposes,	537	1
B.		
BEAVER DAM BROOK.		
Metropolitan Water and Sewerage Board authorized to improve,	814	1
C.		
CHELSEA CREEK.		
Metropolitan Water and Sewerage Board authorized to lower water mains in,	755	1
E.		
EMPLOYEES, STATE.		
publication of lists of, law relative to, amended,	534	1
I.		
INTEREST.		
rate to be paid for real estate taken or injured by Metropolitan Water and Sewerage Board fixed,	525	1
L.		
LABORERS.		
in employ of Metropolitan Water and Sewerage Board, minimum wage of,	685	1
M.		
METROPOLITAN WATER LOAN BONDS.		
issue of, authorized for improvement of Beaver Dam Brook,	814	4
issue of, authorized for lowering Metropolitan water mains in Chelsea Creek,	755	2
METROPOLITAN WATER AND SEWERAGE BOARD.		
may construct additional branch sewer in Somerville,	377	1
may improve Beaver Dam Brook,	814	1
may lower water mains in Chelsea Creek,	755	1
relative to rate of interest on damages for real estate taken or injured by,	525	1

Chap. Sect.

METROPOLITAN WATER DISTRICT.
relative to allowances to cities and towns in, for water furnished from their own sources, ... 422 1

METROPOLITAN WATER SYSTEM.
appropriation for maintenance of, ... 353 1

N.

NEWTON.
may permit entrance of sewage from Riverside Recreation Grounds into sewer of, ... 769 1

NORTH METROPOLITAN SEWERAGE SYSTEM.
appropriation for maintenance of, ... 352 1

Q.

QUINCY.
may sell water for mechanical and manufacturing uses, ... 154 1

R.

RIVERSIDE RECREATION GROUNDS.
sewage from, may be disposed of through Newton sewers, ... 769 1

S.

SOMERVILLE.
Metropolitan Water and Sewerage Board may construct additional sewer in, ... 377 1
relative to drainage of Medford Street in, ... 558 1

SOUTH METROPOLITAN SEWERAGE DISTRICT.
examination relative to disposal of sewage from and extension of said District, ... Res. 83 –

SOUTH METROPOLITAN SEWERAGE SYSTEM.
appropriation for maintenance of, ... 351 1

SPOT POND BROOK.
to provide for investigation and report on improvement of, . . . Res. 100 –

W.

WATER.
relative to allowances for, to cities and towns in Metropolitan Water District furnished from their own sources, ... 422 1

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